Precision SHOOTING

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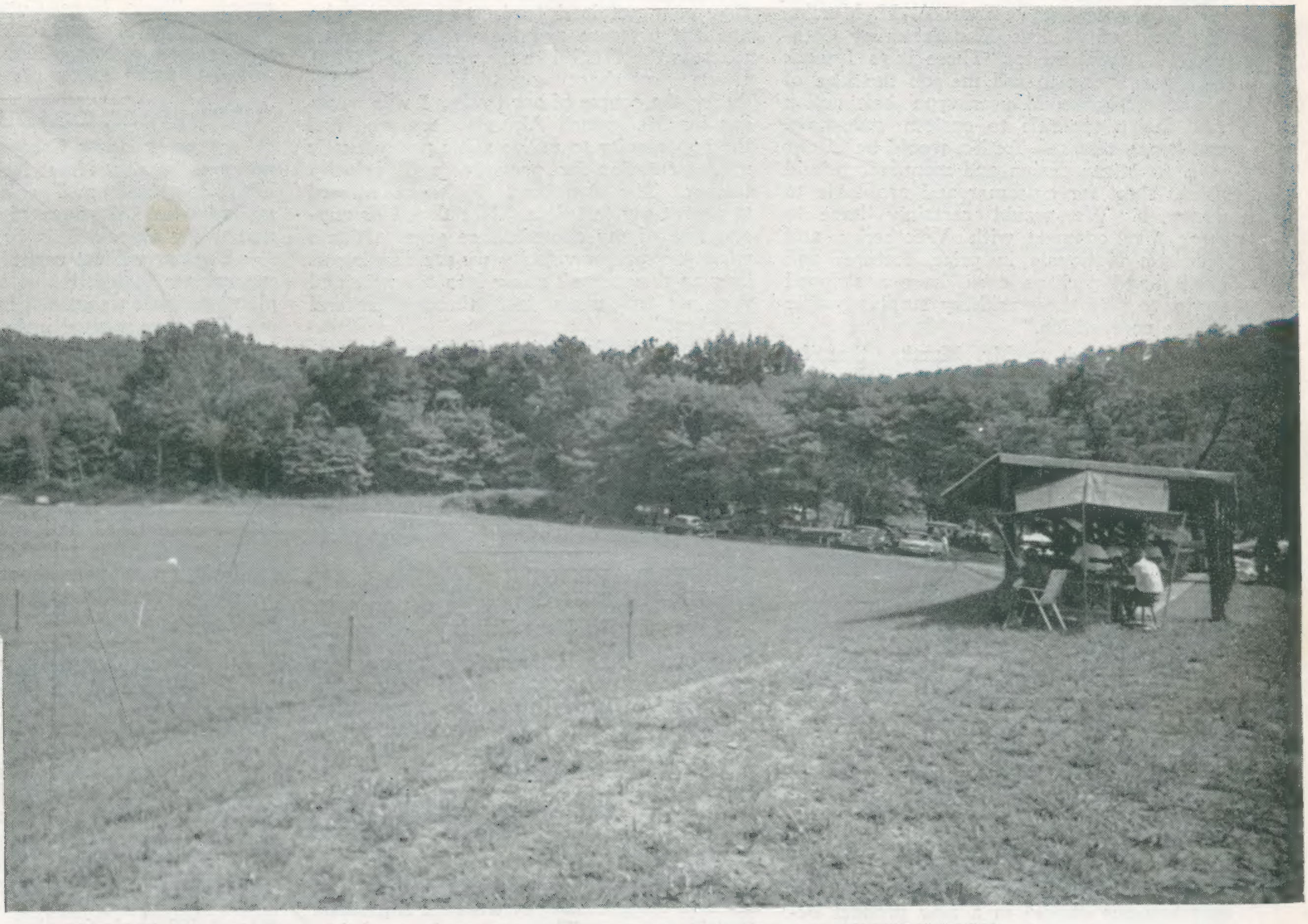

THE COUNCIL CUP RIFLE RANGE AT WAPWALLOPEN, PENNSYLVANIA
The photo was made durnig the firing of the inaugural bench rest match on August 12th and 13th, 1961. The tree-bordered country club lawn expanse between firing line and targets should be easy on the eyes while providing sporty shooting problems. A comfort feature is the tree shaded parking and rest area in the right background. Essential comfort facilities for campers are provided.

a magazine for Shooters by Shooters

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DO YOU WANT IT?

In the past a good many individual shooters and gunsmiths have complained because they could not buy, separately, a good, new, U. S. production made bolt action to use for the foundation of a custom built rifle.

In a recent letter from A. H. Murtha, President of Kodiak Manufacturing Company, he mentioned: "These boys I work with are trying to sell me on the idea of manufacturing a Mauser type bolt action rifle action for sale to custom gunsmiths and bench resters. Action would be of our own American design and manufacture and priced right for customer and profitable to gunsmith. We would certainly have to more than compete with Weatherby and Fabrique Nationale in price, features and quality and perhaps even have a stripped model to give these military surplus people a little competition."

I suggested to Mr. Murtha that he sound out a representative sampling of prospective purchasers of such an action to get an idea of what the demand might be and to also get suggestions on features of such an action that would be desirable.

Since you people are as concentrated a "representative sampling" of gun-nuts and gunsmiths as I know of, I felt it would be a service to you to provide the opportunity to express your desire for such an action (if you do want it) and to suggest features you consider desirable in an action.

Mr. Murtha has accepted my suggestion, we are passing along the information and it is now up to you people to do what you want to about it.

In accepting my suggestion, Mr. Murtha commented; "We may incorporate all, a few, or none of the suggestions made but at least we will know what is wanted."

So far as we know, this is the first time that an open invitation has been extended to prospective purchasers and users to suggest features desired in a new product before the product design is even on the drawing board. We wonder how it will work out.

Our one experience with a completely Kodiak designed and manufactured rifle leads me to believe these people are fully capable of designing and manufacturing a quality rifle action, such as is being considered.

Address any letters you may write in regard to this proposed action directly to:

Mr. A. H. Murtha, President
KODIAK MANUFACTURING
COMPANY
P. O. Box 185
North Haven, Connecticut

P. H. T.

THE 6MM/HLS CARTRIDGE

We have just received from CONSOLIDATED ARMSLUBE, P. O. Box 1238, Alamagordo, New Mexico, some interesting information sheets regarding their new 6MM/HLS cartridge and rifles chambered for it, as well as other specialty items for loading and rifle care which they are producing. We presume these information sheets are available to any interested shooter who will request them but we do urge that those who may request them will enclose a coin to cover postage—these fellows are just getting started and will appreciate that courtesy.

In a letter accompanying the information sheets, Ralph Saylor, one of the firm members, comments about the 6MM/HLS as follows:

"After 6 years of testing 27 different case designs we feel very confident that the HLS case is optimum for the 6MM bore so far as loading flexibility is concerned. Another feature which the smaller cases get into trouble with is the comparative absence of trouble from powder fouling. I think the smaller cases just don't burn enough powder to burn out the fouling from shot to shot. Then too, the smaller cases are finicky in that your pet load tends to go sour with ambient pressure and temperature changes whereas the HLS, like the venerable 22/250, seems to shoot anything. Incidentally, during the course of our testing I was working for McDonnell Aircraft Corp. and had the opportunity to utilize some pretty exotic instrumentation for pressure and velocity testing. The American Rifleman refused to accept my test data. Not that I or anyone else of my acquaintance gives a damn what pressure or velocity we are running as long as they are all going into one hole and your pet ten cases last through several matches!"

Ralph Saylor quite effectively demonstrated the accuracy of the 6MM/HLS in competition at the Texas State Varmint and Sporter Championships last August. Competing in a field of 20 in the Sporter class matches on the San Angelo range, Saylor won the grand aggregate with a .666 MOA average, a full .140 MOA smaller than his nearest competitor.

FORSTER-APPELT HANDGUN SLING

By Kent Bellah

Forster-Appelt, Lanark, Illinois, who make the most versatile of all case trimmers, and a variety of other accessories, have designed a handgun sling. It isn't in production as this is written, but I'm sure it will be soon. It's quite practical. Handgun hunters have multiplied like rabbits in recent years, and the short tube is no longer looked on as strictly a military, police, or target gun.

My sample sling is attached with a sired on the gun butt, or where it is possible to drill and tap. The gun can be carried in a hip holster, if desired, with the sling in place around your neck, ready for instant use. Or, the gun can be carried in the trousers waistband, or like binoculars. The sling eliminates any chance for loss of your gun. One sling can be used on several guns, of course, as it detaches quickly.

It permits holding the gun quite steady for precision shooting. With the right hand extended (for right handers) the thumb of the left hand is placed in the small loop, and the right forearm gripped with the left hand. This forms a rigid triangle. The large loop is adjustable for proper tension. This loop is shortened for use with low powered rifle scopes on handguns, or extended for iron sights.

Few handgunners used scopes until I talked (or begged) Maynard P. Buehler into producing his famous scope mounts for handguns. Maynard was willing to make me a custom mount, and he had used a glass on a handgun, but he didn't believe they would sell in large enough volume to tool up for formal production. I did, because I'd paid $45 for a custom mount when prices were cheaper, and I knew such mounts would sell at a reasonable price. Maynard tells me they are selling real good.

The Buehler handgun mount story was in this journal before mounts were available. Buehler was swamped with inquiries. Same deal with the Forster-Appelt handgun sling. I believe a good many handgunners over the nation will want one. If my comments are heeded, John Appelt will start production promptly. The firm was quick in bringing out my suggestion for a Hollow Point Accessory for the excellent Forster Precision Case Trimmer. I understand this has been justly popular. You can drill hollow points in loaded ammo for better bullet expansion and more shock on game. Drilled cavities seem to expand better than those that are cast or swaged in bullets. Their Nose Cutter quickly faces off sharp bullet noses, making a more deadly flat point type. These can also be drilled to make hollow points.

NEW SPEER LOADING MANUAL

Speer Products Company have just announced a Big, New Reloading Manual. This combined and enlarged edition is packed with 280 pages of up-to-date information for all reloaders, beginner or expert.

Popular wildcat cartridges from the #4 manual are included plus a new and complete section on shotshell reloading.

The new manual includes over 250 pictures and illustrations of components, equipment and how to-do-it instructions. An added feature in this issue is the end tab index for quick easy reference to all loading data, etc.

Loading information on the 22 Jet, the 308 Norma and 44 Ruger Carbine will also be found in the New Speer Manual, plus fifty-five standard and wildcat cartridges and seven pistol cartridges. The manual is available now at your shooting goods dealer or by sending $2.95 to Speer Products Co., P. O. Box 244, Lewiston, Idaho.

LETTERS

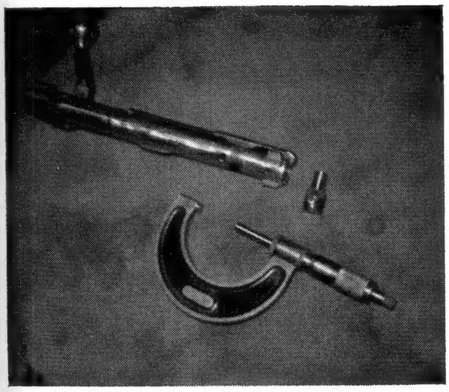
.308 LOADS

Dear Sir:

.... Seems that you commented some time ago on the grouping ability of your M-110 Savage. I had some real fun this summer in Florida out on Santa Rosa Island. With the 30 Cal. Pope lead bullet and 13 grains 4759 I managed to hold the 308 M-110 of mine for a .763 MOA aggregate at 100 yards for 100 5-shot groups. The 168 grain Sierra International with 40 grains 4895 averaged .817 for 100 5-shot groups! The Pope bullet was seated in the throat and the same case was used for the entire 500 rounds—retaining the powder with a cardboard wad. Bullets were 1 part tin and 40 parts lead and were not weighed but only given a casual inspection. Lubricant was AeroShell 500—a hi-lo temp. aircraft grease.

FOULING SHOTS UNNECESSARY

Also remember seeing in P. S. some comment relative to shooting fouling shots after cleaning in order to condition the bore for group shooting. Would like to pass along this kink for what it is worth. Since most nitro solvents commonly used contain



MEASURING FIRING PIN PROTRUSION

By K. E. Smith

Ahead of the bolt in the photo is a depth gage for measuring firing pin protrusion. In using, the striker is placed in fired position, gage pushed over firing pin protrusion, locked with a small thumb screw and miked over all.

The gage is exactly one inch long and using a 1" to 2" mike, the reading will be the amount the firing pin protrudes.

I like my firing pin points to protrude .055" plus or minus .000" to .010" and as near to a well polished half diameter radius as possible.

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oil, the problem is solved by getting rid of the oil in the bore after cleaning by running 2 wet patches of Energine through the bore and then drying with about 5 patches. During the course of our tests on the 6MM we found out early in the game that the best shooting combination then with Sierra bullets was good for about .625 MOA from an uncleaned barrel over a 100 round 10-shot group test, whereas thorough cleaning with solvent, then de-oiling as noted above after each 10-shot string cut .127 MOA off the aggregate (without using fouler or warmer shots).

During the match at San Angelo last August, the only shots fired at the sighter target were those shot in an effort to peg the rapidly shifting conditions and many matches were fired without a shot except on the record target and the rifle was cleaned as above after each match. If I knew something about mirage we would have really murdered 'em as Ed Landers, my partner, had fired a practice match here before leaving for San Angelo with my HLS rifle with a .379 MOA aggregate—and I have fired several practice NM courses since I got back which were under .475 MOA.

R. R. Saylor
Alamogordo, N. M.

NBRSA MEMBER REPLIES TO WALLACK

Dear Phil:

I have just finished reading Mr. Wallack's letter regarding the recent National Championship matches held at Johnstown and I have some comments to put to him.

First, I am one of those working stiffs that fired the four days at the matches, and let me say that I planned to attend the matches all year and when it came time to choose vacations in my office, I fought like hell to get the two weeks I did. And let me say too, Mr. Wallack, that had I not been able to get a vacation at the time asked for, I would have been at Johnstown nevertheless. There were three of us up there from Staten Island and if any other shooters felt like they wanted to shoot, they were also there. Some things get to be mighty important to me, and this was one of the more important things.

IN CALIFORNIA . . .

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MARIAN POWLEY
17623 Winslow Rd., Cleveland 20, Ohio

Announcement by KENRU

Now in stock and ready for immediate shipment, the "MY SPECIAL" SIERRA .30 caliber Jackets, as described in the August issue of this publication. Available in the following lengths: 1.050", 1.150" & $1.250" @ $16.00 per M, plus postage for seven (7) pounds.
I also wish to express my thanks and appreciation to the many that helped me with their checks and money-orders, sent in advance for their initial orders.

KENRU Reloading Service
166 Normandy Avenue
Rochester 19, New York

As for being able to afford to shoot at Johnstown, I feel that if a person really enjoys his hobby, cost is not a factor. Personally I save up my money a few dollars at a time and when I have enough to buy a particular piece of equipment, I go get it. I have a family just like every other average person and occasionally find myself lacking the cash to do things I want. But this doesn't stop me from attending matches. If Mr. Wallack would care to look at the scores of various shoots he would see that I have fired in eleven matches in two years. My scores are mostly down at the bottom of the pile, but then somebody has to be down there. And since I am young, I can afford to be happy there. **But at least my name is on the aggregate list. When was your name on the aggregate list recently, Mr. Wallack?** I mean I don't see them in PS magazines from 1954 to date. I looked carefully.

Mr. Wallack speaks of the attendance at the shoots. Percentage wise of total membership, NBRSA championship matches have enjoyed an average of 15% attendance at least (12% in 1961—Ed.). Perhaps Mr. Wallack would care to relate the percentage of attendance to NRA enjoys at Camp Perry. Then let Mr. Wallack tell us where he finished at the recent Camp Perry shoot.

Bench rest shooting dying, Mr. Wallack? Look again friend; the NRA says I am in the Top 20 and actually I finished number 36. The NBRSA is far from dead, but I know some few people that have lost a lot of faith in the organization that proposes to save our guns for us. Naturally I am flattered by the great compliment paid to me, but there are 16 other people that are a mite angry at having been eliminated from the Top 20 at Johnstown! There were 84 hard shooting men (and women) up there, and they didn't stop trying to win for all four days. How come you stopped after only one day of shooting?

Regards from a rest shooter,
John C. Farrell
Staten Island, N. Y.

ISU COURSE NATIONAL CHAMPIONSHIPS

The first United States National Championships for the full schedule of International Shooting Union courses were fired on the Army Advanced Marksmanship Unit's International Course ranges at Fort Benning, Georgia during the period of October 24th through November 6th. Championships were for the recognized International Shooting Union courses with rifles, pistols and shotguns. For each category the full ISU course was fired on each of three succeeding days, the aggregate score for the three days being the championship score. The champions and runners-up were:

INTERNATIONAL SLOW FIRE PISTOL: Fired October 24-25-26. Winner was SFC Samuel W. Hunter, USAAMU, with score of 1657 X 1800. His daily scores were 565--545-547. Runner-up was Air Force Captain Franklin Green with score of 1649. U. S. Marine Warrant Officer William B. Eubank was third with a 1645. High civilian shooter was Los Angeles policeman John Hurst who placed 14th with a score of 1621.

INTERNATIONAL 100 METER RUNNING DEER: Fired October 24-25-26. Winner was Army 1st Lt. Willis D. Powell with a three day aggregate score of 1244. Runner-up was SFC Lloyd C. Crow with 1241 X 1500 and third was Sgt. Norman O. Skarpness with 1239. All three are USAAMU members.

INTERNATIONAL FREE PISTOL FOUR MAN TEAM: U. S. Air Force 2177, U. S. Army 2173 and U. S. Marine Corps 2153.

INTERNATIONAL PRONE SMALLBORE RIFLE: Winner was Army 1st Lt. Tommy G. Pool with a three day aggregate score of 1752 X 1800. His daily scores were 580-582-590. He defeated teammate Capt. Daniel B. Puckel by a single point (1751). In third place was Air Force T-Sgt. Edward E. Cagyle with 1742. Miss Janet Friddell from Toledo, Ohio, was the only civilian entry in the field of 27 and she fired the 11th ranking score of 1729.

INTERNATIONAL SKEET: Winner was 1st Lt. James R. Clark, USAAMU, with a three-stage aggregate of 297 X 300. Runner-up Sgt. Major Harold A. Grewe, USAAMU, had to win a shoot-off with U. S. Navy Seaman Kenneth D. Sedlecky when both showed final totals of 294 X 300. Army's four-man skeet team took national honors with 776 X 800. Air Force 763, Navy 754 and Marines 742.

INTERNATIONAL RAPID FIRE PISTOL: Marine Corps Capt. William B. McMillan won with a three-stage aggregate of 1768 X 1800. His daily scores were 587-594-587. Army 1st Lt. Cecil L. Wallace was runner-up with 1763 and Marine M/Sgt. Frederick W. Filkins was third with 1748. John R. Hurst, Los Angeles Police, was high civilian with 1732. U. S.

(Continued on Page Seventeen)

50,000 ROUND ACCURACY LIFE COMING?

By John Culling

The purpose of this investigation was to aid in the development of a barrel steel that would give substantial increase in "accuracy life" for high intensity cartridges. The ultimate objective was not a better understanding of the cause or mechanism of barrel failure except as was felt would be of aid to the program.

In this program the term "accuracy life" is meant to apply to the approximate number of rounds fired before accuracy begins to deteriorate appreciably. Many individuals in this country own small arms of one sort or another which might not be fired more than 200 times over a period of twenty years or more of ownership. We encounter hunters in the field during deer season who haven't fired a single round in over a year. These people are obviously not concerned with better rifle barrel steels. There is also the rim fire plinker who fires thousands of rounds of .22 Long Rifle ammo without any concern over loss of accuracy.

Perhaps at the opposite end of the spectrum in the sporting or pleasure shooting world is the bench rest enthusiast, who may shoot 3000 or more high velocity rounds a year. He generally knows that his pet high velocity match or varmint rifle is ultimately destined to lose its tack-driving accuracy no matter how carefully he cleans it. The newcomer in this field may not as yet know that bench rest records are scored as the distance between the centers of the two widest bullet holes in a target. At the time of this writing the NBRSA record for the smallest five-shot group at 100 yards range is the amazing .063 inch target shot by Harold Zieser at Johnstown, N. Y., August 30, 1958. The five-shot record at 200 yards is .2383 inch. The current ten-shot record groups are .1969 inch at 100 yards and .3830 inch at 200 yards.

Such records represent the ultimate in rifle precision today in the unrestricted rifle class in which there is no limit on rifle weight or sighting equipment. In the light varmint rifle class the NBRSA rules restrict total rifle weight including scope to 10½ pounds with scope not to exceed 8X. Many shooters are able to fire frequent five-shot 100-yard groups from the bench rest of .75 inch or smaller even with some of the "untuned" factory rifles of recent manufacture. Typical high velocity bolt action sporting rifles made after World War II will deliver bench rest groups of 1½ to 2½ inches with factory ammunition and adequate sighting equipment. While it is obvious that groups will run larger when shot offhand or in some manner other than from the bench, the above figures are representative of modern rifle accuracy capabilities.

Assuming that other factors affecting accuracy such as bedding and ammunition are correct, the question is raised as to just how long a barrel will shoot before it begins to spray bullets all over the country side. Many factors enter the picture. With proper care and cleaning even the very soft iron barrels dating back a hundred years or more will last almost indefinitely if soft lead bullets and small amounts of cool-burning powder are used at low temperatures and pressures. Rifles made for .22 rimfire cartridges have shot a half million rounds or more with no detectable barrel wear.

Barrel wear with harder jacketed bullets and increasing velocity with larger amounts of powder burned at higher temperatures and pressures is another story. Modern steel barrels chambered for medium velocity cartridges such as the .30/06 Springfield or the .308 Winchester are capable of gilt edge accuracy life of about 4800 rounds and sufficient accuracy for practical hunting of 10,000 rounds or so. Plain carbon or nickel steel barrels used to give accuracy for about 1000 rounds with top loads in the hotter cartridges like the .270 Winchester. Chromium-molybdenum steel barrels are said to increase this life to about 2400 rounds. Cartridges like the fully-loaded .220 Swift were good for about 1000 rounds in the older steels and something like 2300 rounds in the newer 16% chromium stainless barrels. Very large capacity cartridges like the Weatherby line are accurate for about 1200 rounds in the better steels. The accuracy life in present day barrels may be roughly approximated by the formula:

$$\text{Accuracy Life} = \frac{100{,}000{,}000\ (\text{Caliber})^2}{(\text{Charge Weight})^2}$$

Even the enthusiastic hunter who may shoot his sporting rifles quite a bit can live with this situation because rebarreling his pet rifle only costs $50 to $65 and reboring even less. But a target or varmint rifle may well have only one superbly accurate barrel out of a half dozen or more rebarreling jobs.

Semiautomatic or full automatic military weapons are another story again. The higher the temperatures involved the more intensified become the factors contributing to accuracy deterioration. At the same time the hotter the barrel metal becomes the less resistant it is to these factors. The temperature of a steel barrel in full automatic fire of 600 rounds per minute climbs almost immediately to 1100° F or higher. For those not acquainted with metal temperatures, a piece of steel at 1100° F may be seen to glow red in dim light. That is hot! The Rockwell instrument is generally used to report gun part hardnesses, but it is more convenient at this point to refer to a different hardness measurement system—the Brinell Hardness. Ordinary chromemoly barrels are currently heat treated for service to hardnesses registering between 240 and 320 on the Brinell scale. These correspond to metals whose tensile strengths would run in the range of 110,000 to 150,000 pounds per square inch. At 1100° F the tensile strength of such steels has dropped to the neighborhood of 30,000 to 40,000 p. s. i., while the Brinell Hardness runs a mere 70 to 80. These values are comparable to those of cold aluminum in the medium-soft condition. Even the now famous Type 430 stainless steel has fallen to 31,000 tensile and about 75 Brinell Hardness at 1100° F. The newer Timken 17-22-AS steel still retains 70,000 p. s. i. strength and 180 hardness at 1100° F. It would not be correct to infer that resistance to barrel erosion may be judged solely by strength and hardness, but these figures serve to show the drastic effects of heat on metal properties.

The selection of a metal for a specific engineering application generally represents a compromise of many factors, not the least of which are ultimate cost and machinability. In the case at hand it is doubtful if there would be much of a market for rifle barrels that cost $3000 each even though they might have an accuracy life of 20,000 rounds or more. The best metal for automatic weapons would in all likelihood not be the best selection for sporting or target arms.

The end of barrel accuracy begins in the throat just forward of the chamber neck in the modern high velocity rifle. The effects of continued firing may be observed in most cases by looking through the breech, not directly through the bore but at an angle. The first portion of the lands are rounded, while the throat area has a slightly frosted appearance. An excellent discussion of "Erosion in Gun Barrels" is given by Creighton Audette in the June, 1961, issue of **Precision Shooting.** The firing of a charge of nitro-cellulose powder in a chamber developing about 51,000 pounds per square inch pressure develops a flame temperature in the region of 5000° F, though the barrel metal doesn't approach this temperature. The combustion products include water vapor, nitrogen, hydrogen, carbon monoxide, carbon dioxide, and methane.

As pointed out by Mr. Audette, it has been chemically and metallurgically proven that the nitrogen under these intense temperatures and pressures actually combines chemically with the interior surface layer of

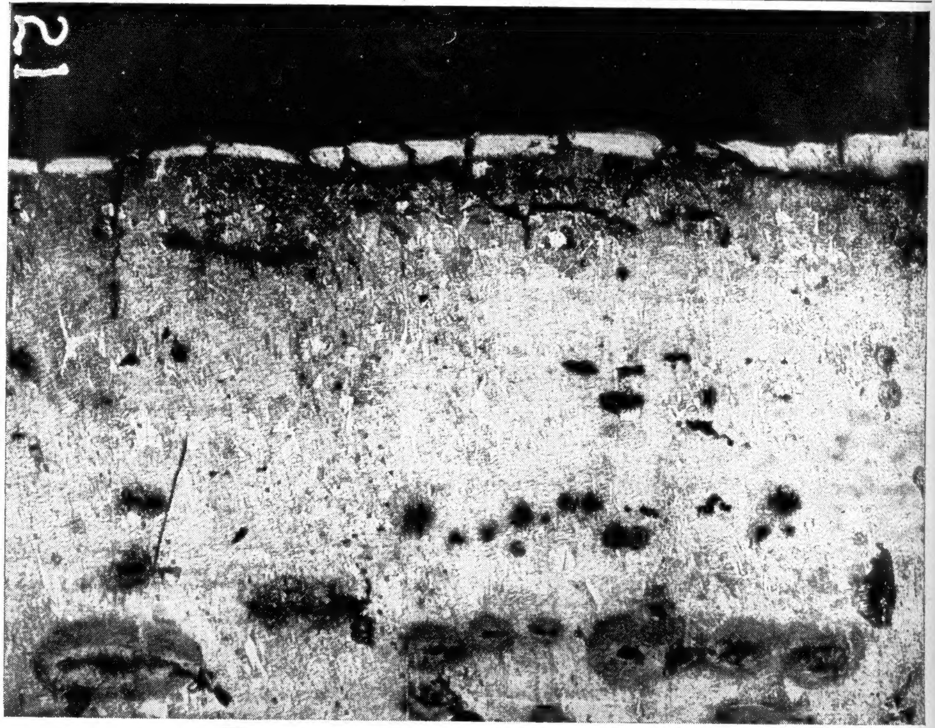

Figure 1. .244 Rem. ¼" from chamber. 100X

bore metal to form an extremely hard, brittle layer of iron nitrides. This layer is referred to by ordnance men as the "white layer" and may be observed in Figures 1 and 3. Figure 1 is a photomicrograph taken by sectioning a .244 Remington barrel at a point ¼ inch in front of the chamber neck and magnified 100X.

A similar hard, brittle carbide layer is commercially produced by exposing metal at high temperature to gases such as carbon monoxide and methane. However this would seem to be negligible in gun barrel erosion, since nitriding proceeds at approximately 250 times as rapidly as carburizing at the temperatures apparently involved.

As a bullet moves along the barrel in firing the gas pressure drops while gas temperature falls off more rapidly. Since nitriding depends upon time, pressure, and temperature, it is generally confined to the first few inches of bore in front of the chamber.

While the hardening and embrittling effect of nitriding alone would not cause barrel erosion in the throat area, it nonetheless aids and accentuates a second destructive factor. The surface skins of gun bores are stressed beyond the endurance limit of present day steels used in high velocity barrels. The intense heat generated by powder gases penetrates into the bore skin causing it to expand very rapidly. After each shot, or burst of shots, the hot skin is drastically quenched by the colder outside portion of the barrel resulting in rapid contraction. Surface failure of metals produced by repeated thermal stresses has long been associated with rapid heating followed by rapid cooling, the more rapid the cycling, the more severe the stresses.

The phenomenon called craze-cracking or "fire-cracking" is influenced to a considerable extent by metal properties. Thermal shock may be defined as a sudden change in temperature. Ductile metals respond to thermal shock by deformation but seldom break, while brittle materials are likely to fracture. This would be "thermal shock failure." When thermal shocks are applied repeatedly the ultimate structural damage is referred to as "thermal fatigue." Cracks caused by one or both may be observed readily in all of the photomicrographs in this article. Thermal shocks often cause thermal fatigue, but even repeated slow heating and cooling may produce the same kind of failure though generally less rapidly and of less severity.

Figure 2 is a view at 100X looking at the surface of the bore of the .244 Remington of Figure 1. Such cracks have begun to develop after very few high velocity shots have been fired through present day steel barrels. Further firing develops more and deeper cracks, and the nitriding of the bore skin begins to take place. Figure 3 ¼ inch from the chamber neck shows the nitrided layer to be approximately .001 inch thick. It may be seen that the "white layer" is absent from Figure 4 at 100X and Figure 5 at 500X. These pictures were taken 9 inches from the chamber of the same .244 Remington barrel. The temperatures and pressures have evidently dropped to low enough values within a few inches of the chamber to halt the nitriding process.

The hard, brittle nitride layer behaves somewhat like enamel on metal. It is easily cracked and chipped away by mechanical forces or thermal shock only to be formed once more in the freshly exposed surface. While the thermal fatigue alone eventually causes bits of the surface to erode away, the nitriding greatly accelerates the process, a fact which is demonstrated in the more rapid erosion in the nitrided area at the breech end. Temporary restoration of accuracy is occasionally obtained by cutting off part of the breech area and setting back the barrel. The results of this process are generally disappointing since the bore interface is already craze-cracked so that the nitriding and erosion proceed more rapidly than before.

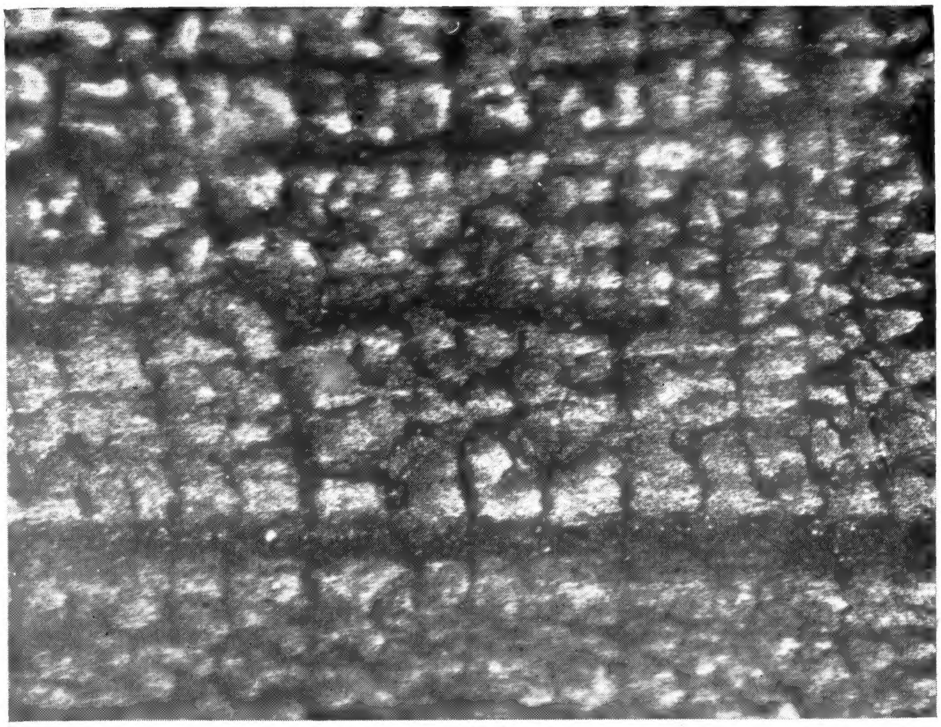

Figure 2. .244 Rem. ¼" from chamber. 100X

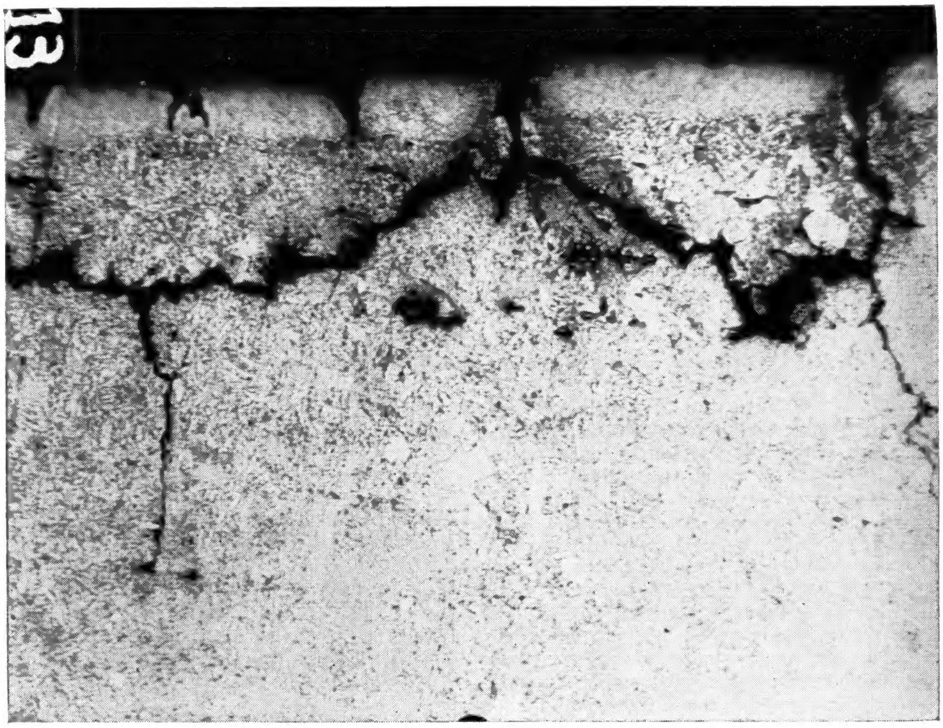

Figure 3. .244 Rem. ¼" from chamber. 250X

Just plain frictional erosion and "washing away" of the bore surface of powder gases become more significant in softer less heat-resistant barrel metals. Old .45/70 barrels go out very rapidly if modern hard jacketed bullets are fired through them with smokeless powders though the pressures may be held quite low.

What we seek then for long accuracy life in a rifle barrel is a metal possessing high coefficient of thermal conductivity, high specific heat, high yield strength, high ductility, and good machinability, combined with low coefficient of thermal expansion, low modulus of elasticity, and resistance to nitriding. Sufficient hardness to resist plain frictional abrasion is also required. Pure molybdenum comes admirably close to the ideal compromise in physical properties but is extremely difficult to machine and would cost about $650 just for a barrel blank at current prices. Other attractive "exotic" metals are even more expensive and less machinable.

Confining our search to the alloy steel family, we find that there is very little variation from one to the next in modulus of elasticity or specific heat. Other properties may be altered considerably by suitable changes in chemical composition and heat treatment. Unfortunately most alloying additions to a steel that enhance one desirable property all too often increase one or

(Continued on Page Six)

50,000 Round Accuracy Life Coming?

(Continued from Page Five)

more undesirable properties. Almost all additions lower thermal conductivity. Silicon additions to steel reduce its tendency to nitridge but tend to make it more susceptible to thermal fatigue by reducing ductility. Chromium increases resistance to nitriding markedly. Figure 6 is a photomicrograph at 100X taken in the throat of a Type 430 stainless steel .220 Swift barrel; note the absence of the nitride layer. It may be recalled that the Swift is good for about 1000 rounds in steel barrels susceptible to nitriding and almost 2500 rounds in a stainless barrel resistant to nitriding.

Unfortunately the type of stainless used in barrels at present is relatively poor in hot strength and most other properties, though it machines fairly well. The Timken 17-22-AS alloy has relatively good hot strength and thermal conductivity, but its thermal expansion coefficient is still fairly high.

All steels, including the three stainless types, may be metallurgically divided into four groups: ferritic, pearlitic, martensitic, and austenitic. Each group is characterized by certain properties as indicated in Table 1. There are a few specialized steels that are actually a combination of two or three of the basic types listed in the table, but even within each basic type we can see that considerable variation in properties may be obtained. This isn't to say that the maximum values for all properties are obtained together. Extremes of one property are generally obtained with unfavorable values for others.

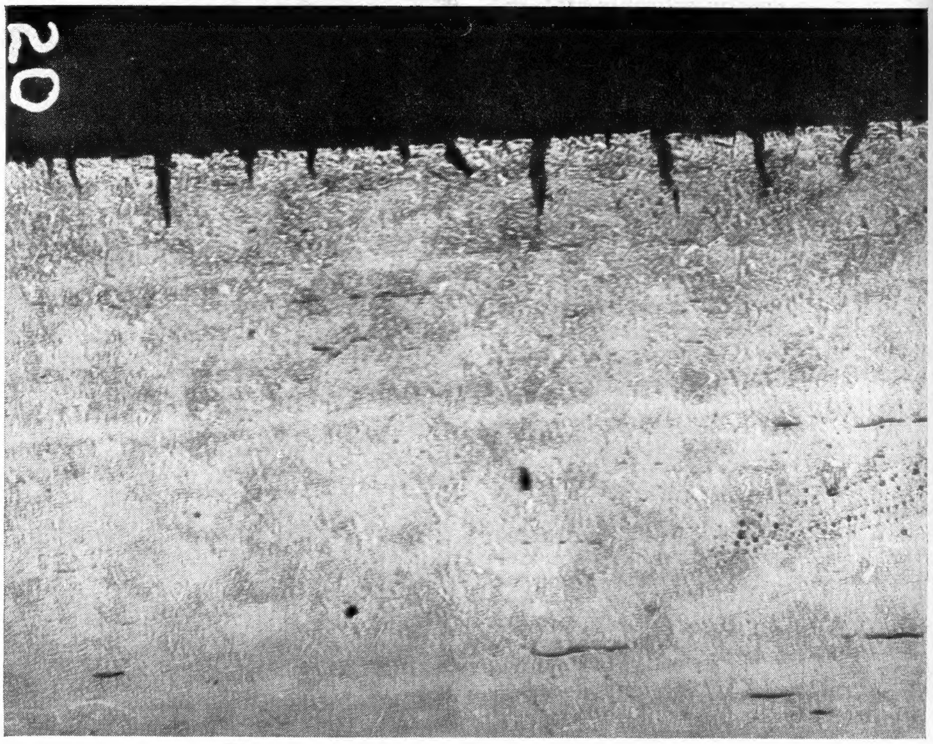

Figure 4. .244 Rem. 9" from chamber. 100X

Table 1

METAL TYPES

PROPERTIES	Pearlitic	Ferritic	Martensitic	Austenitic
Basic Material Cost per lb.	$.06-$.10	$.06-$.45	$.18-$2.80	$.23-$8.00
Total Alloy Content, %	1%-5%	1%-30%	2%-34%	24%-100%
Thermal Conductivity, 70° F	300-400	120-400	145-185	83-110
Therm. Exp. to 1000° F, x 10-6	7.8-8.0	6.2-8.0	6.4-7.5	7.2-10.4
Machinability Rating	10-70	50-140	6-65	10-70
Hot Strength	Poor	Poor	Good	Excellent
Wear Resistance	Fair	Poor	Excellent	Fair
Ductility	5%-60%	12%-30%	2%-15%	10%-75%
Resistance to Nitriding	Poor	Poor	Good	Good
Brinell Hardness	220-490	100-200	140-750	120-470

All commercial barrels to date are ferritic or pearlitic steels with the exception of the Timken alloy 17-22-AS and a few tool steel barrels occasionally made by custom gunsmiths. Even within the ferritic family a change from Type 430 (16% chromium) to Type 446 (25% chromium) would bring some improvement in barrel life without excessive cost or loss of machinability. Other ferritic steels do not look very attractive.

Turning to the austenitic metals, we are immediately confronted with medium to very high costs, generally poor machining qualities, low thermal conductivity and in most grades high thermal expansion. Barrels would not cool rapidly, and high expansion may mean more shift of zero with heating warpage than would be expected from other types. These steels do however have superb hot strength at higher temperatures. The only real hopes in this family of alloys would seem to lie with the most complex and expensive variations.

The most fruitful field for exploration at present to obtain good accuracy life among the steels seems to be in the martensitic group. Many steels in this class are characterized by reasonable machinability and conductivity, low expansion, moderate price, and very good hot strength to about 1200° F. The simplest grades have good strength only to about 1000° F, but newer compositions may push the present 1200° F ceiling even higher. Metallographic studies indicate that the bore interface metal near the chamber end of a high velocity barrel reaches temperatures somewhere between 1000° F and 1500° F, with the first .001 inch or so going much higher.

What is needed now to point the way to future development is for someone to try a barrel of one of the best martensitic stainless available today such as the Carpenter Steel Company's H-46. It may be seen from Table 2 that H-46 has sufficient chromium to combine the fine resistance to nitriding of the present ferritic stainless with the good hot strength of the martensitic 17-22-AS. This should provide the best qualities of both and give substantial improvement in accuracy life. If it does, it would indicate that the craze-cracking occurs around 1200° F or lower and we would know metallurgically which way to further alter composition. If H-46 gives disappointing results craze-cracking would seem to be taking place above 1100 to 1200° F, and we would look to austenitic or semi-austenitic alloys for further development. Temperatures of the extreme inner layer of the order of .0001 inch deep may actually reach 2800° F or higher; the actual interface itself appears to have undergone fusion as suggested by Figure 5. All steels fuse at this temperature or lower; what we

Figure 5. .244 Rem. 9" from chamber. 500X

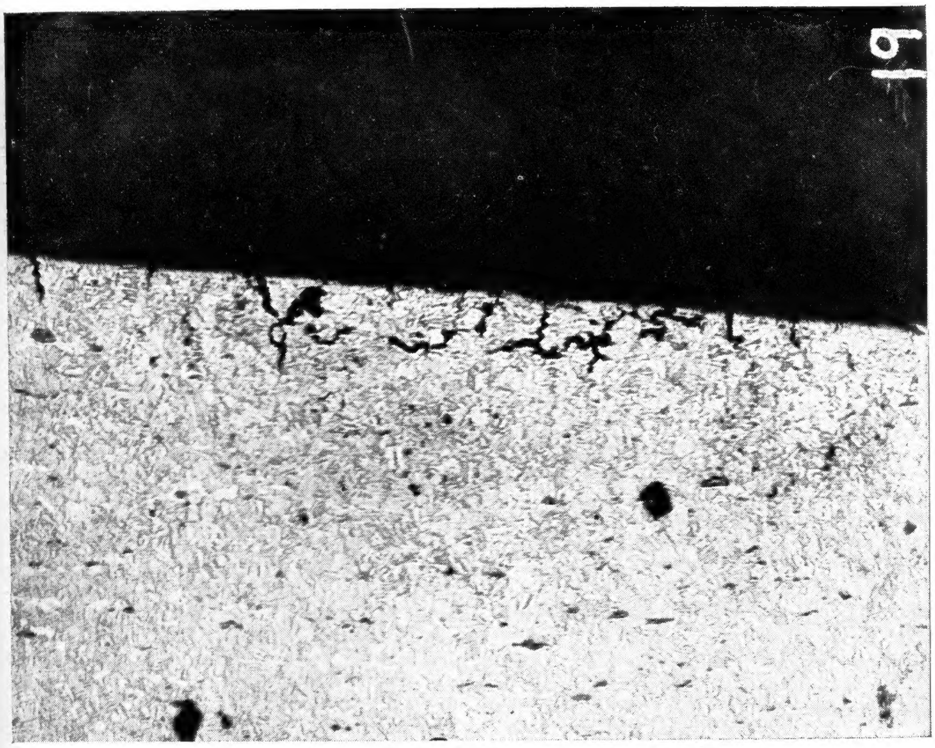

Figure 6. .220 Swift ¼" from chamber. 100X

Table 2

COMPOSITION, PER CENT

	Cr	Mo	V	Cb	Ni	N
Type 430 Stainless	14	——	——	——	——	——
Timken 17-22-AS	1.25	.50	.25	——	——	——
Carpenter H-46	11.5	.70	.30	.40	.50	.08

are concerned with in the choice of steel is failure deeper in the bore metal.

Tests have been conducted with barrels containing bore coatings of alloys of chromium with iron, nickel, and cobalt, alloys of cobalt with tungsten, and duplex coatings of chromium with copper, cobalt, and cobalt-tungsten alloy. None of these have proven thus far to be superior to properly formed chromium layers electrodeposited in layers with hardnesses equivalent to 500 to 900 Brinell. No evidence of melting of plated chromium has ever been reported; chromium melts at approximately 3430° F. Extensive firing tests of chromium-plated barrels varying from .22 caliber to 3-inch cannon indicate that barrel life in slow fire may be doubled over unplated bore life, while rapid fire life may be increased as much as fivefold. Best results are evidently obtained when the thickness of the plated layer runs about one-half to two-thirds of the land height near the chamber. It is claimed that there is improvement in both accuracy and accuracy life if the thickness of the plated layer tapers up to a thickness at the muzzle and approximately equal to land height thus giving a sort of choke effect. While better bore-coating materials may be developed in the future, there is metallurgical evidence that the present chromium plate may be at its best in alloys like H-46.

Meanwhile remember that the life of current steels is inversely proportional to the square of the powder charge in a given caliber. That is, doubling the charge just about cuts accuracy life 75%. Cutting the charge about 10% increases life about 20%. Save your Super-Streak Hummingbird Express for hunting. Load as lightly as possible to get the desired results. Light bullets of extreme velocity in a given rifle destroy accuracy more rapidly than heavy bullets and lighter charges despite the increased bullet friction. Remember also that heat is the enemy of barrel life. Do not regularly fire more than about two shots per minute; it is best if you never allow your barrel steel to become hot enough to be uncomfortable to the touch.

WIND AND MIRAGE

By Jesse M. Grigg

Many a knot in the maze of mirage and wind effects has been unraveled, but never yet the master knot. Much has been written on the subject, and been seized upon, with mingled hope and resignation, by shooters already hardened to disappointment; yet good outdoor shooting is still largely a matter of luck and good judgment, or possibly the sixth sense which top ranking shooters are said to have.

Lest false hopes be raised, it is stated that the answer is not in what follows. This is a description of causes and effects. The causes are the existing meteorological conditions which, as every shooter knows, may be recognized in only a limited degree. If they could be known fully, and if they remained constant long enough, the effects might be predicted with a great degree of accuracy. As matters are, with conditions largely a matter of guess, and likely to change as the shot is fired, wind and mirage is still an unsolved problem.

The source of all the trouble is earth heat that has been received from the sun, this heat, by warming the adjacent air, creating the circulation that is wind, and the light refraction that is mirage. The wind is known only by the strength and direction of the force which it exerts on objects in its path. Mirage may be seen, but the presence of light refraction is known only by the fact, established by firing, that the target is not where it seems to be. Thus the wind gives notice before the shot is fired; light refraction gives notice after the shot is fired.

Wind moves the bullet itself; light refraction bends the sight line. The effect of wind is difficult to estimate because, on the rifle range, it is the interaction between both the prevailing wind and the local wind. Light refraction, wholly a local phenomenon, is even more of a distressing problem because it depends for deception on the momentary and unseen arrangement of the moving heated air between the shooter and the target. Thus the main difficulty with both lies in the fact that each varies with time and place on the firing line, this fact perhaps accounting for the difference between scores fired by shooters of equal abilities.

As stated above, the wind in both strength and direction is the resultant of the prevailing wind and those of local origin. A prevailing wind is one which blows fairly steady in strength and direction over a large area for a considerable time. An example is the west wind which is the result of earth rotation that exposes in turn to the sun the areas of land and sea which make up the earth's surface.

Winds of local origin, like prevailing winds, are due to unequal pressures that are the result of unequal earth heating; but, unlike the prevailing, the local wind is a circular affair which rotates about a particular spot of either higher or lower pressure, as the case may be. Such rotating winds are called cyclonic or anti-cyclonic, depending on whether the direction is anti-clockwise or clockwise. Clockwise is the direction if the center of rotation is a high pressure or cool spot; and anti-clockwise is the direction if the center is a low pressure, or warm spot. The fact of pressure difference, and not the degree of heat or cold, is what causes the wind.

To account simply for the anti-clockwise wind, it is supposed that the sun is shining on a bare field which is surrounded by better shaded terrain, such as tall-grass covered land. Over the bare field the air is heated more than is air above the better shaded surrounding. Warm air being lighter, it tends to rise and draw in from the sides cooler air to take its place. The influx is greatest at the ground where nominal air pressure is greatest. But the warmer air cannot all rush to one particular spot in order to rise; so, like steam when the pot begins to boil, it breaks up irregularly into bubbles which are called thermal cells, each of which independently rises and draws in other air at the base of its respective column, each being the source of a local wind. A rifle range on a hot, bright day is ideal for the origin of such winds.

According to Ferrel's Law, when a gas or liquid converges upon a point the resultant motion is a circular one whose direction of rotation is anti-clockwise in the northern hemisphere, and clockwise in the southern. A familiar illustration is the whirl of water as it falls through the orifice of a sink. Conversely, if the flow proceeds away from a source, an example being water under

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(Continued on Page Eight)

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Wind and Mirage

(Continued from Page Seven)

pressure and entering a reservoir at a bottom opening, the rotation directions are the opposite of the above. Thus, in this hemisphere, when air is going up, as at a warm spot, it is surrounded by an anti-clockwise wind, and when going down, as at a cool spot, it is surrounded by a clockwise wind.

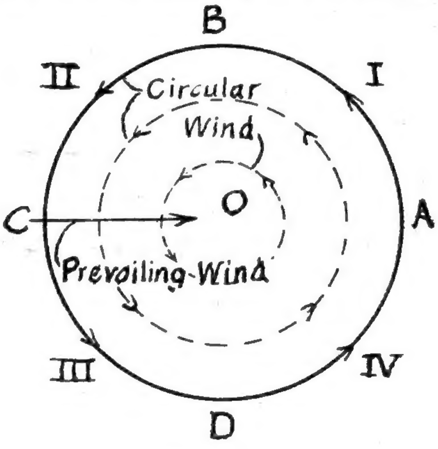


FIG. 1

The point O, Fig. 1, in an anti-clockwise wind is called the storm center whether the disturbance be a destructive tornado, or merely one of the tiny whirlwinds that, at certain seasons, hurry across the ground sucking up dust and leaves. On a warm summer day the winds which plague the match shooter are likely these cyclonic winds, rotating about local storm centers, going and coming, one after another, on the prevailing wind.

The circular wind, like all others, is prone to be chaotic. Every tree or other obstruction impedes and deviates it. Moreover, friction drag of the earth's surface exerts a braking force at the ground, this tending toward irregular motion. At the same time also, the prevailing wind, while carrying along the thermal cells, or rotation centers, combines vectorially with the circular winds themselves, thereby giving a variety of strengths and directions which are differently apparent at different places of observation.

If the prevailing wind blows from 9 o'clock, Fig. 1 ,and the storm center therefore is moving, all the circles of the rotating wind likewise are moving, and the resultants of the two winds are changing at every time and place of observation. At the instant when the storm center is at the place denoted by O, the wind strength on the line OB will equal the difference between the prevailing wind and the rotating one. On OD it will equal the sum. During the complete passage of the circular wind over the denoted area, directions in certain sectors which contain C and A will be reversed, while at B and D gusts will be registered. Repetitions of these many effects are due to fact that one storm center and circular wind is followed by another. Always if the prevailing wind is strong and is full of thermal cells gusts will be prevalent. When a gust is approaching it will reach the tree tops before it is felt on the ground, this owing to fact that the air is moving upward also in approach to a storm center. For a similar reason, when the gust is leaving, the lull is felt by the tree tops before it is felt on the ground.

A passing cloud complicates matters. It creates a temporary cool spot where the descent of air causes a clockwise wind which may upset the sequence and pattern that has been prevailing. For reverse reasons the pattern may be upset when the sun breaks through a clouded sky and causes an anti-clockwise wind, and maybe a disastrous change in the refraction of light.

The direction of the storm center of an anti-clockwise wind is easily determined if this wind is the ruling one. Face the wind and the storm center will be on your right. Thus if flags are posted on the range it is a simple matter to know whether the wind is a circular one. If the direction at the firing point is different from that at the butts one may be sure that a wind is rotating about a storm center which is not far distant. Another sign is a difference of direction between two or more flags at the same instant; and if these indications are changing one may be sure that a prevailing wind also is involved. If the wind is choppy, this means a prevailing wind that is full of thermal cells.

In the latter respect it was recently my experience to be on a range in an extreme case of such a wind, a case in which the prevailing wind was literally shot full of tiny thermal cells. The feel of it as I got out of the car told me to dope with a wind-vane instead of a streamer, and this proved to be a good hunch. The wind-vane would change ends and back quicker than a hound dog that has blundered into a nest of bumblebees; at other times would come a complete lull of short duration, while only a few feet away the grass blades were inclined by wind; yet at no time did the trees stop waving. I tried to fire only at the instants when a dead spot passed over me; and insofar as I succeeded in this the shots went in. They went in because the total effect of many little whirlwinds is zero, leaving only the steady effect of the prevailing wind. This reasoning goes also for a single rotating wind whose storm center is halfway between the shooter and the target.

Usually the shooter has only his streamer indications at the firing point and maybe a flag indication at the butts with which to estimate the effect on the bullet, but even a knowledge of wind directions at these two places alone may be put to valuable use. If these directions are opposite, the effect on the bullet will be much less than the effect of winds in the same direction. If the wind is blowing at only one end of the bullet path, the direction of the bullet deflection will be the direction of the wind which is blowing. These are particularly important rules in wind doping.

Obviously it is folly to shoot by the indications of a streamer alone. This is especially true if the wind comes from behind the firing line. The streamer may indicate only local conditions that depend on the proximity of trees, automobiles, and buildings. In nearly any case the wind will be stronger out on the mown range than it is at the firing line, this owing to less ground resistance. So, if no flags are posted and no mirage is flowing, one should attempt to determine the strength and distribution of the wind by movement of weeds and trees, and dust at the backstop.

In scope shooting, conditions out on the range possibly may be learned by dipping the rifle to study the intervening distance. If the wind pulsates, as most winds do, the way to determine from the motion of the close-cropped vegetation which way it blows is to note the side to which the waving stems swing the farthest. This is in accord with the principle that when a gust suddenly strikes a streamer or flag the initial swing with the wind is about twice what will become the angle of steady deflection for that wind. Similarly if a wind strength is suddenly diminished, the streamer will fall back initially to about half of what will become its steady deflection in the diminished wind. These principles of motion apply also to the rifle that is being pushed around by wind.

However, wind is mainly a spring and fall problem. In mid-summer the number one problem is likely to be mirage, or maybe a combination of light wind and mirage. Nonetheless, though mostly a mid-summer trouble, mirage, like the wind, is present summer and winter, excepting such times as when strong wind, snow or falling rain cools the ground so rapidly that the adjacent layer of air is not perceptibly warmed.

The visible effects of mirage do not reside in the heated air or vapor itself. What gives the mirage appearance is the distorted picture of landscape or irregular color beyond the heated air. For illustration look just over the flame of a cigarette lighter at a terrestial background, and the background will appear to dance. Against a background of blue sky no movement is seen. For similar reasons of homogeneity no flow or dancing is seen against the white of the target, but at suitable distance perturbation may be seen above a good radiator of heat.

You can see homemade mirage by looking just over the top of an electric hot plate at a terrestial background which is either near or distant. To the naked eye the background appears clear, though continually dancing, or moving sidewise if a sidewise air current disturbs the rising column. Through a good spotting scope, placed between you and the hot plate, the details of the background, if distinct at all, are distinct only at random spots in occasional fleeting instants. This to say, periods of blurring and clearness irregularly alternate with respect to different places in the background.

This difference in definition between viewing with the naked eye and viewing with the scope is explained as follows. With the naked eye one sees, not a small magnified area, but a larger whole area, which does not all become blurred at the same time, this because the rising air column is heterogeneous as to refraction. Thus, owing to eye memory, enough of all the background is retained to connote the general appearance of it. But when the background is seen through the scope, the components of any particular small magnified area come clear so infrequently and for such short intervals that they do not register a distinct picture, and the whole appears blurred. Application of these principles to the telescope on the rifle range makes apparent that the greater the magnification or the smaller the objective lens, the poorer the definition in refracted light, which is exactly in accord with experience.

Insofar as the shooter is concerned there are two ways in which light refraction due to heat are manifested. One is the appearance of flowing waves which serve to indicate the direction of the air movement, possibly without greatly bending the sight line. The other is a condition of refraction which does bend the sight line, yet gives little or no visible indication of its presence. This is the kind which gives a 10 on the sighter, and a 9 on the record, the kind which makes competitive shooting a game of chance instead of skill.

The reason why the shooter does not see where he looks is because his sight line passes obliquely through air strata of different densities. Inequality of density is due to inequality of temperature. Inequality of temperature is due to fact that the air is warmed only by contact with the earth, and therefore is warmest at the ground, while at some distance above grade its temperature depends more on circulation than on conduction.

A reputable textbook on plane surveying states that the total thickness of the warmed layer is seldom more than four feet, and usually not more than three. As this layer is the zone of refractive error, the book states also that no sight line in surveying should pass closer than three feet from earth at any point, and further states that no important sighting should be done in the heat of mid-day. Obviously these are precepts which match shooters should, but cannot strictly follow, as the sight lines of prone shooters who lie on the ground always pass closer than three feet from it. Moreover, as regards other shooters, it is possible that the professors may have erred regarding the height of the heated stratum. There are days when one, standing erect and observing the shimmer of heated air, may easily believe this.

As light refraction is manifested to the shooter in two different ways, the discussion must naturally be divided into two parts. One part must refer to the generally invisible refraction which givse no advance notice of its presence. The other must refer to the case of visible flowing waves, which branch of the subject contains two subdivisions. One pertains to heterodyne, the other to interference waves, though these types sometimes differ only by being associated with wind conditions which themselves differ so slightly that it is hard to say which is one and which the other.

The interference phenomenon is manifested by distinct, swiftly flowing waves in a condition of almost still air. The heterodyne phenomenon, in which the waves are less distinct, occurs under conditions which will be recognized as those in which the shooter observes the direction and appearance of flow to estimate the effect of wind on the bullet. The heterodyne case is to be treated first.

In this phenomenon the prerequisite of flow is a multiplicity of thermal cells rising between the observer and the background, and being carried sidewise by a moderate wind. In a refractive sense, each cell has the properties of concave refracting media of very weak power, yet the collective effect of all through which a light ray passes sensibly bends it. As the field of thermal cells can hardly be homogeneous, this fact alone would cause aberration in the appearance of the background. But further, as equal sidewise movements of the refracting cells at different distances from the eye correspond to different angular displacements, the heterodyne principle combines aberration into waves which are long enough to be visible after they have been magnified by a telescope.

The motion of the thermal cells due to wind is at the base of this phenomenon. If the wind is too weak the phenomenon becomes one of the interference type. If the wind is too strong no flow at all is visible, for not enough heat is imparted by the ground to the adjacent air. Nonetheless, when the heterodyne type of flow is manifested, its direction corresponds to the direction of the cross component of the wind. For this reason that fact is used by the shooter to determine wind direction out on the range.

Naturally the first question is, Where on the range is situated the wind to which the flow refers? In answer is stated that, in absence of refraction, the background itself is seen in closest detail when the scope is focused for background distance, say 100 yards. Then if a refractive condition, moving or still, comes into the air, the rays which form the image will be bent in proportion to the mean total of aberrations between the shooter and the background, assumed to be 100 yards. This is explained by saying that if the distance between the shooter and the background be divided into equal elements and all their respective aberrations be added in proper sign the sum will be the mean total of light bending. Thus the observed striae depend not on air movement at one particular place, but on all movements, right and left, between the observer and the background. This is to say the appearance will refer to the mean of cross wind velocity.

If now the scope be focused for less than background distance, say 50 yards, the image of the 100 yard background will appear blurred. Nonetheless, in suitable conditions, this blurred background will be delineated in wave motion. This is because, of the many light rays emanating from the heterogeneous background, those which cross at focal distance will be affected most by refraction which takes place between the shooter and the plane of focal distance. Over this intermediate distance, say 50 yards, the wind indicated is again mean wind between the shooter and the plane for which the scope is focused. Proof is had in the fact that the appearance of background and flow disappears if the scope be focused for very short range.

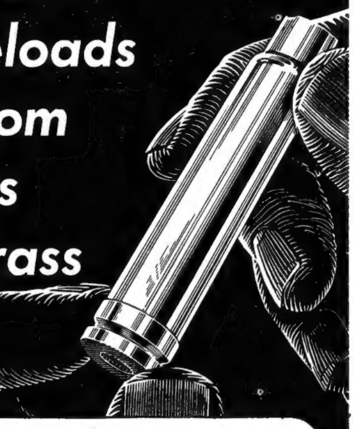
However, it is difficult to believe that the speed of the waves is a measure of the wind velocity. When the wind is strong enough the flow disappears altogether because not enough heat is imparted to the air by the ground. Moreover, when the wind is negligible the observed flow may be that of interference waves, which are relatively fast, and are visible when the wind is insensible. Nonetheless, as the direction of heterodyne flow does indicate the direction of the cross component of the mean wind, this fact is valuable information when the wind is strong enough to blow a bullet off course.

For interference waves the usual condition is an expanse of approximately stagnant, and perhaps moist, warm air in which the temperature diminishes with respect to horizontal distance from a point which, for example, may be the storm center of the warmed air. Possibly there may be a number of such expanses moving slowly across the range.

For a better understanding of the resulting wave phenomena I shall first describe two simple experiments which the reader himself may perform if he has suitable lenses. For the first demonstration move crosswise before the eye a convex lens of low power (a plus spectacle lens will do), at the same time looking through it at any convenient background. The background will seem to move in a direction opposite to that in which the lens is moved. Now do the same with a weak concave lens (a minus spectacle lens for example), and the background will seem to move in a direction same as that of the lens. As a cell of heated air has the refractive properties of a concave lens, this is the reason why motion of the thermal cells causes the background to have the seeming of motion in the same direction as that of the cells. However, if the air out on the range were colder than that where the observer is situated, the waves might flow against the wind.

In the second experiment hold the edge of a convex lens in good light against a sheet of white paper with the lens plane at right-angles to the paper, and look almost parallel with the plane of the lens. Due to interference of light reflected from the lens, dark semi-circular rings may be observed on the near surface of it. These, though curved because the lens is circular, correspond to the parallel, vertical dark lines which are seen in flowing waves.

(Continued on Page Thirteen)



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TO ALL OFFICERS, MEMBERS AND FRIENDS OF THE N. B. R. S. A.

Best wishes for a Merry Christmas and a Happy, Prosperous and Enjoyable New Year.

From your President,
Bob Hart

PRESIDENT'S CORNER

DIRECTORS AND MEMBERS: We have a problem, and not being a member of the ostrich family I cannot bury my head in the sand. I am going to present it as fairly as I know how, with caution to ALL to give careful evaluation, calm thinking, and above all there should not be any harsh words or ill feeling between members. Unfortunately we had a similar situation a few years ago that created some ill feelings; this is past and I hope forgotten. Let us all join together for a fair solution of this situation.

This problem affects only the unrestricted rifle class and I am certain that if a solution is not found this class will dwindle to a mere handful of competitors at each shoot and I am including our National Match. Regions of the N. B. R. S. A. are being affected in varying degrees but the full effect will eventually be felt by every region. The problem is; "The use of heavy rifles and precision rests."

Before proceeding any farther I want it clearly understood that this equipment is legal and within the rules. The men who created it and use it are within their rights. They have made a contribution to our aims, that of extreme accuracy, and this fact is recognized by the major number of active bench rest shooters. But like all things that are accomplished, they are bound to bring reactions and this is no exception. The reactions that have come to me, some direct and some indirect, are the reason for this article. (It would have been much easier to ignore these reactions but I don't think any President has the right or privilege to do so.)

The complaints are not loud or threatening, but are calm and quiet statements of their position in regard to the problem and this is cause for worry.

Naturally I have no exact figures but I think an estimate of 20% who attended the Nationals this year at Johnstown have decided to drop the unrestricted class and more are undecided. This we must avoid if at all possible. Am I crying WOLF? I certainly don't think so. This is the most difficult column I have ever tried to write and I am only doing so on the conviction that a solution must be found if the unrestricted class is to flourish.

A condensed summary of the complaints are as follows: Can not afford to add the price of a precision rest, of the type needed to compete; that they are not able to carry a 40 to 60 pound gun to the bench; where are the weights going to, inasmuch as there are no limits? The combination of these are too much to expect of the average shooter. There are others but these are the main bone of contention.

To say that the above combinations do not have an advantage would be stupid in the extreme. New worlds records are being set at a faster rate than ever before. The accuracy has improved to a point that is unbelievable to one who is not familiar with our sport. BUT THE PROBLEM STILL REMAINS. Will our unrestricted class defeat itself and our hopes of building a good sized shooting fraternity?

I do not have the answer. Some of the suggestions are: To limit the weight of the unrestricted rifle; if a rifle weighs over a certain number of pounds it must be shot from a sand bag; and others, but these are restrictions and bench rest shooters do not take kindly to additional restrictions. Another suggestion is that the clubs utilize the rules we now have by setting up a match program for the unrestricted rifle open class and for the limited class, to provide an equal base of competition. This has merit for it would not restrict the progress of accuracy.

We need a solution and each member should study this fairly, not for personal gain but in the best interest of the N. B. R. S. A. Your elected officers spend much time and thought in providing an enjoyable shooting program for you. Now it is up to **YOU** to consider this carefully and then advise your director or deputy director of your answer to this dilemma.

This situation is not endangering the immediate life of the N. B. R. S. A. It effects only the unrestricted rifle. Many who are now shooting in this class are planning to shoot in the Varmint classes only. Our Varmint class has done well and I predict that 1962 will see an extreme increase in the number of Varmint class shooters. This is wonderful. Our membership is increasing but credit for the major part of this increase must be given to the Varmint class shooters.

The question is: Can our organization continue its purpose and strength if we do not have a healthy and competitive unrestricted rifle program? The National Matches held in the Eastern Region are a barometer of what is happening. These matches held on alternate years have shown a registration loss of approximately 25 shooters per match for the past three (3) matches, or 75 shooters in six (6) years. True, the Nationals at Tulsa in 1960 showed an increase of 15 shooters over 1958 at Tulsa and this is hopeful in that area but this is not the over-all picture.

Our members are a group of independent and positive thinkers who will not be pushed into anything This is not an attempt to do so, but an earnest effort to act as a leader to this problem.

Until December,
Bob Hart

EASTERN REGION WINTER MEETING

The Eastern Region NBRSA annual Winter Meeting will be held in Mark Twain Hotel, Elmira, New York, Saturday, January 13th and Sunday, January 14th.

Bench Rest Match Reports

SOUTHBORO, MASSACHUSETTS

In spite of cold, rain and some snow, sixteen shooters fired in the final bench rest match of the season at the Southboro Rod and Gun Club range on October 15th. Shivering shooters displaced wind and mirage as the principal shooting hazard at this shoot.

But in spite of uncomfortable weather, some excellent groups and aggregates were made. Bob Stinehour won the day's aggregate with a .4045 average for the five 5-shot and five 10-shot matches, all at 100 yards. Dr. A. H. Garcelon was second with .4195 and Crawford Hollidge third with .4400.

Prizes for this (and all shoots at Southboro this year) were gold, silver and bronze medals to the three with best aggregates for the day. In addition a perpetual season aggregate trophy was established for the smallest grand aggregate for the three matches of the season.

Stinehour was winner of the annual aggregate trophy with a three match aggregate average of .4521. Dr. Garcelon was second with .45335, Crawford Hollidge third with .51325 and Mary Hollidge fourth with .52575.

Brunon Boroszewski from Buffalo and Al Abramow from Rochester, N. Y. fired their .308 cal. rifles at this shoot, Brunon making a ten-match aggregate of .756" and Al a .816".

RICHMOND, INDIANA

The first registered bench rest match conducted by the Fraternal Order of Police on their new range at Richmond, Indiana, on October 22nd drew an entry of 12 shooters who christened the new range with a record threatening 100 yard group and near record aggregates.

NBRSA secretary Bernice McMullen shot a 10-shot group at 100 yards that was range measured at .162 inch and has been submitted for official record judging.

Ferris Pindell, who is moving to California right away where he will be working for Sierra Bullets, Inc., put on an outstanding "hello-and-goodby" performance on the new home range. He shot smallest 200 yard group of .425 inch, won the 200 yard aggregate wtih .3695 MOA, was third in the 100 yard aggregate with .362" and won the NMC aggregate with .365 MOA.

Irv Potter, Dayton, Ohio, won the 100 yard aggregate with .320 and was second in the NMC aggregate with .384. Al Roberts, Louisville, Ky., was second in the 100 yard aggregate with .322.

"Cowboy" Rucker from Akron, Ohio, was second in the 200 yard aggregate with .4120 MOA and third in the NMC aggregate with .392 MOA. National Champ Cline Deere was third in the 200 yard aggregate with .4295.

Potter didn't win a 100 yard match but was second in two of them and his biggest 100 yard group was .390". Pindell won the frist 100 yard match with a .240 but his .250 group in match 4 was only good for third place. Paul Gottschall won the second match with a .250 but his .280 in the following match was only good for a third place. Pete Chagares' .355" group in the last 100 yard match was the biggest group to take a third place at 100 yards. Nine of the twelve shooters had 100 yard aggregates under .400.

The biggest 200 yard group to take a third place was Pindell's .970 inch in the fourth match. Six had 200 yard aggregates of .500 MOA or under and nine had under-half-minute-of-angle NMC aggregates.

FRESNO, CALIFORNIA

A total of 26 riflemen competed in the Southwest Region Bench Rest Championships conducted by the Fresno Rifle Club on October 21 and 22. The program included matches for unrestricted bench rest rifles (12 competitors); heavy varmint rifles, (15 competitors); light varmint rifles (6 competitors) and .22 cal. rim-fire (7 competitors). The .22 R. F. matches were included chiefly to permit sponsoring club members, who had never shot in bench rest competition and did not own bench rest rifles, an opportunity to try this type of competition.

In the tabulations the left hand column is the 100 yard aggregate, center the 200 yard aggregate and right hand the NMC or grand aggregate. The award winners were:

UNRESTRICTED BENCH RIFLES

Chester Pluth	.381	.9965	.6887
George Hendricks	.567	.9213	.7441
Robert Rowland	.512	1.0032	.7576
George Fullmer	.694	.8602	.7771
Allen Hobbs	.593	1.1044	.8487
Felix Marinovich	.510		

HEAVY VARMINT CLASS

E. A. Suchan	.542	.5411	.5415
George Hendricks	.514	.7313	.6226
Allen Hobbs	.443	.8952	.6691
George Fullmer	.672	.8253	.7486
K. E. Smith	.684	.8686	.7763
Robert Rowland	.454		
Henry Wright	.594		
John Shirinian		.7608	

(Wright and Shirinian shot 30/06 cal.)

LIGHT VARMINT CLASS

John Sweany	.912	1.0247	.9683
Joe McPhillips	.890	1.1374	1.0137
Allen Hobbs	1.221	.9297	1.0753
Jack Bridwell	1.141		
R. J. McDougel		.9101	
E. A. Suchan		.9212	

.22 RIM FIRE

Henry Wright	1.189	1.9292	1.5591
John Shirinian	1.299	1.8187	1.5593
Bob Perkins	1.660	2.0928	1.8760

All 100 yard matches were fired on Saturday and all 200 yard matches on Sunday.

A CORRECTION

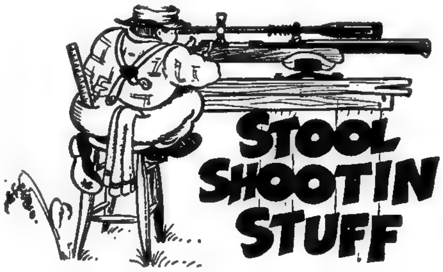
In the announcement of the TOP TWENTY ranking shooters in the 1961 National Bench Rest Championships at the banquet following the final day of shooting, W. T. Hopfengardner from Dayton, Ohio, was credited with 13th place, and was so listed in the report in the September issue ot Precision Shooting.

At the time the announcement was first made, Mr. Hopfengardner was aware that he had disqualified in one match, thought this was one of the record matches but hoped that he may have been wrong and that the disqualification may have been in a "warm-up" match. Before leaving Johnstown the following morning he checked up at the statistical office and found that his disqualification had been in a record championship course match. He immediately notified the NBRSA President (who was still at the range) of the error and returned the TOP TWENTY award that had been presented to him.

The Precision Shooting editor was not aware of this error prior to publishing his reports of the matches in the September issue of the magazine.

Now, after checking the official results bulletin for the shoot, it appears that Alfred Walter, St. Louis, Mo. and NBRSA Director for the Mississippi Valley Region, is the 20th ranking shooter with a championship aggregate of .5270 MOA.

P. H. T.



Dear Phil:

Merrie and I are off for a week or two of deer hunting, come daylight tomorrow morning and as usual, the period before such a trip has been a hectic one. I always like to get as many of my bullet orders out as I possibly can, and it seems as if when you are in a hurry, there are always a few people who want some special things. These fellows who want the special items usually turn out to be my best friends and I hope I never reach the stage where I am like some of the big corporations who have to reject an item that varies the least little bit from the normal product of a production line. A fellow in Saudi Arabia insists on having some special 7 m/m bullets and another fellow from New York State wants to shoot big horn sheep with his 7 m/m Magnum and be sure that the bullets break up or expand properly at real long ranges. One might think that I could just go down to the tools and mix up a few ingredients and come out with just the right answer as simply as Grandma did when she mixed up a batch of sugar cookies but it just isn't that simple. If bullets are to be made right for such special hunting conditions, they have to have every bit as much care taken as those that would be used for a big benchrest event. One of the first problems in such special bullet making is to get the right jackets and the standard sizes available in each caliber are pretty much limited. This frequently necessitates drawing larger caliber jackets down from lengths that are normally longer than those in the smaller sizes. Of course, drawing them makes them still longer and sometimes, to make a real good bullet, the jacket mouth has to be trimmed much the same as you would trim the neck of a case in one of L. E. Wilson's fine tools. So far as I know, Mr. Wilson doesn't make a gadget for holding jackets for trimming but in case you or some other fellow would like to get involved in such an operation, it is easily accomplished with the aid of a special sized draw collet such as RCBS makes for drawing bullets. A piece of 1" OD diameter stock is taper bored for the collet and a cap screw readily pulls the collet into the taper and snugly holds the jacket as you shorten it to any desired point by means of the case trimmer.

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I had occasion to use my trimmer in making up some 145 grain 7 m/m bullets which incorporated quite an exposed section of lead tip. I have the feeling that Winchester's new power point bullet is a step in the right direction and although perhaps it won't be as inherently accurate, as the hollow point benchrest type bullet, the destruction of game is the main objective of most bullets. A bullet similar in performance to Winchester's was my objective, and I hope that Merrie and I can give you a first hand report.

I use the word "hope" because last week when I drove up to Maine and cruised around a few areas, I found that the deer were being very elusive and in several sections, the black bear kill had exceeded the white tail, but of course, as the season goes on, Maine's deer harvest should come up close to its normal high level. Incidentally, this level is really pretty high and if my memory serves me correctly, has exceeded 35,000 per year for the last thirteen years. This figure varies somewhat from year to year in relation to the amount of snow fall that occurs in the latter part of November. There is probably an age old attraction between a snow coverage and deer hunting and it seems to have been pretty conclusively proven that when a gentle fall of snow starts, the Maine resident and non-resident alike reach to the gun rack and start out for the winter's table meat.

You can probably guess pretty well what the average gun reached for will be but here are some interesting statistics, to bear out pretty well the oft heard statement that one out of about every four hunters wandering in the woods is carrying a 30-30. The entries in the "Biggest Bucks Club" show that 417 hunters registered deer that weighed before dressing over 350 pounds, and 113 of those trophies were taken with a 30-30. The 30-06 comes second with 87 and the kissin' cousin of the 30-30, the 32 special accounted for 53, and to keep the

(Continued on Page Twelve)

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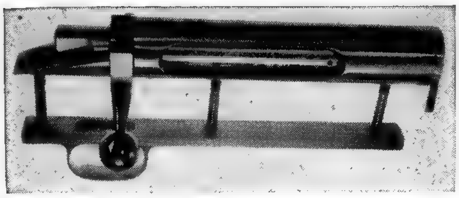

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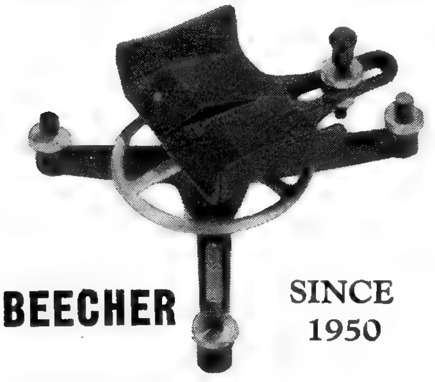

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Stool Shootin Stuff

(Continued from Page Eleven)

kill in the 30 caliber class, 35 hunters used the 300 Savage and 33, the 308 Remington. The only other caliber that got a reasonable honorable mention was the 35 which took 17 of those big heads.

No one was fortunate enough to break the 1955 record of one of Doc Garcelon's neighbors named Horace Hinckley who downed a buck which weighed 438 pounds before it was dressed.

In a breakdown of 15 of the largest, the heaviest one was killed by a Maine resident with the 32 Special, and the 15th one on the list was also killed by a Maine resident with a 22! It was interesting to find that ⅓ of those 15 big deer were tagged by women hunters but what surprised me the most was that only two non-resident hunters came in the top 15. With the great number of non-resident hunters that go to Maine, it seems to me that they must have a propensity for going in the wrong places unless we are to read between the lines and arrive at the idea that these big deer were being shot by hunters who knew exactly which orchard, clover field, or potato patch these big rack wearers were feeding. These statistics show me one thing for sure and that is that I am not too likely to bump into another hunter who will borrow from me or loan to me a spare case for a 7 X 57, but I'm a stubborn cuss and have long been in love with that caliber. It is more or less a foreigner to us as is its running mate, the 8 m/m Mauser which in my opinion is one of the very best of cartridges for Maine deer. There are hundreds of thousands of such rifles in the country and many more thousands have been re-barrelled to some other caliber but I find it hard to complain about the original case. It is short and powerful and a rugged round nosed bullet in it needs a lot of brush to deflect it.

When Hurricane Carla came up the coast a few weeks ago, I was reminded of one of the early benchrest rifles that John Warren made in the midst of the first Cape Cod hurricane that he experienced. Merrie and I had buttoned down everything pretty well, having worked steadily from the hour of the first warning to the time the storm was supposed to break. The big picture window was braced from within and out with 3/16″ steel cable, turn-buckled so tight that they would twang like a banjo string. The lawn furniture was lashed to the stone wall and the garage doors were battened down and the cars backed until the bumpers contacted them from within. The standby gasoline lanterns were ready for a power failure. While I waited for the storm to arrive, I thought I might as well busy myself about something so I started stocking an old Model 95 Mauser to make up for a loaning rifle. This rifle had been given to me by a neighbor who didn't know how to make ammunition for it and didn't consider that it would shoot if he did but I figured that that little 30 caliber cartridge was on a pretty good case. I suppose I should have had my head examined for spending so much time on the stocking and had I been making the rifle for myself, perhaps I wouldn't have, but I didn't want to loan it to somebody and have them think I was a wood butcher at stock making. As the hurricane was delayed, I continued to take pains with the inletting. Quite a few hours later, Carla turned into a fizzle but by the next day, I had the inside of the stock fitted well enough to test when a friend of mine called up and asked if he could come over and test out a $500 custom made 7 m/m that he had just gotten hold of. He made some pretty respectable groups, and while he was waiting for his gun to cool, I thought I would fire a few shots and see how things were going with my half finished stock. I had sawed off the barrel and put on a ramp and front sight with an inexpensive receiver sight. He had been shooting a scope mounted rifle. After I finished four 5 shot groups, he came over and looked through my spotting scope. My groups really were pretty good and showed that the pains I had taken in stocking the rifle had paid off because it is not often that you get better than 1 MOA group out of an old military rifle with a rough two stage trigger pull. Bob Chatfield-Taylor, after looking through the scope, turned to me and rather incredulously said, "Gosh, did you shoot those groups with that crowbar?" Maybe John had something after all in making a stock during a hurricane. We blame good or bad shooting on almost everything else in the benchrest game and although John named his gun after the hurricane, I decided to use Bob's backhanded compliment pertaining to mine, and I named it "The crowbar."

The benchrest game must be doing something for accuracy or I would not be hearing from such a great number of people. One recent letter came from a boy in Anchorage, Alaska who is trying to better the performance of an AMU group who are shooting from skiis, and a chap in Australia wants to know how to make better targets of an entirely different type than those used by the benchresters, but he must have the equivalent in accuracy if he can get it. I have the feeling that some day it may be very essential for our country's future to have reloading and the knowledge of marksmanship so widely known.

I'm among the benchrest gang who probably wouldn't fare too well as a gorilla in a mountain hide out if I had to make frequent forays on an enemy but if they would house me in a cave with some of my reloading gear, I'd perhaps be able to augment to some extent the loss of demolished ammunition factories. The NRA for years has been fighting to have a broad background of knowledge and supply of arms at the finger tips of many citizens. This is surely the time to continue such an effort. Once we are disarmed, we certainly will be in a sorry state.

Phil, I noticed that in my new record for the Sporter rifle, a barrel of 14″ twist was mentioned. That statement was wrong although perhaps I may have been partly responsible for it as I am so used to putting down on my registration card, a listing of a 14″ twist barrel. Bill Cotter chambered this rifle for me several years ago on a 12″ twist Hart barrel and I subsequently turned the barrel down to Sporter size. This rifle really needs a better stock than it ever had but the hurricane season is about over, and I'll need some other incentive to urge me on.

Cordially yours

Ernest Stiehlbutter

Wind and Mirage

(Continued from Page Nine)

For success in this experiment the reflecting lens should preferably be unmounted, and have its opposite-side curved surfaces meet at the rim. A reading glass lens removed from the frame is suitable.

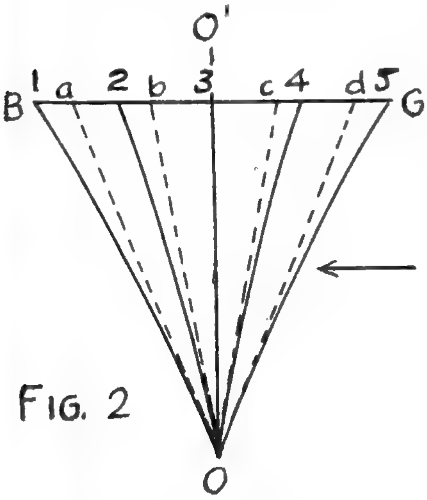

FIG. 2

Proceeding from experiment to theory, the concave lens of these experiments is now replaced by what in Fig. 2 is supposed to be a thermal cell, or region of warm air at the ground, shading off to greater density, or cooler air, on either side of a horizontal axis O'O through the center. Numbers 1, 2, 3, etc. denote particular places in the background BG, the whole of BG perhaps not exceeding in length the two or three degrees which are subtended in the field of an ordinary spotting scope. The lines 1-0, 2-0, etc. denote possible sight lines of an observer at O, these being curved by refraction in opposite directions on the different sides of the axis O'O. The straight lines Oa, Ob, etc., being tangent to the respective curved ones at O, indicate that the observer sees 1 at a, 2 at b, etc. and 3 in its right place because O'O passes through the center of the thermal cell on a line of no refraction.

Note now that if the warm cell be moving from right to left, point 2 will presently be seen in very nearly its right place, point 1 be seen at b instead of a, and so on. Thus is explained why the waves appear to move in the direction of thermal cell motion.

Note further that the distance a3 is less than the distance 1-3, this due to fact that concavity in a lens causes an object to look smaller than it is. The distance between 1 and a corresponds to the amount of windage correction needed to hit point 1. But also observe that, to hit point 5, the same amount of windage in the opposite direction is needed. Here, therefore, is a contradiction because there will be no observed difference in the direction of flow, and no apparent sign to tell the shooter where the neutral axis, or line of no refraction, lies. At the same time, perhaps the thermal cell is in motion, this changing the amount of needed windage from instant to instant. Further, I can vouch by fact of unhappy experience that the direction of the flow may reverse without any change in the course of the wind at the firing point. Altogether, it appears that the shooter may be in the dark most of the time when interference mirage is flowing. Perhaps the best he can do is to shoot to only direction and appearance until he gets caught unless, as sometimes happens, the changes come so slowly that close holding and clicking to the previous shot may keep the target clean.

The second experiment mentioned above utilized the laws on which depends the formation of the dark lines in the flow of interference waves. These phenomena are based, first of all, on the principle that any smooth surface, real or imaginary, but common to two media of different refractive indices, is a surface which will reflect light rays that are incident to it at small angles. An example is a pane of ordinary window glass in air. Two adjoining layers of unequally heated air also constitute an example, as is the case when air above a highway pavement reflects the images of distant objects as if from the surface of water. In this case, of course, the rays between the eye and the object are curved, as the temperature gradient in the air varies with height above ground.

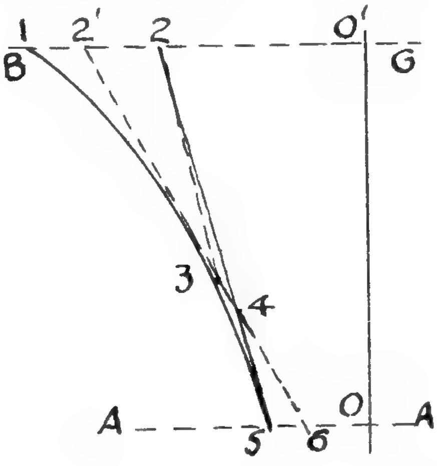

FIG. 3

A possible sight line, curved for the same reasons, is denoted by 1-3-5 in Fig. 3, it requiring for the indicated direction of curvature that the air be warmer on the right side of the curve than on the left. 1 is a place in the background BG; and 5, in a plane parallel to BG, is where the observer is assumed to be situated. As 1-3-5 is a reflecting surface, any point on it (or for that matter on any similarly chosen curve) will reflect light rays at an angle equal to the angle of incidence. Accordingly, as a matter of convenience let 2 in BG be chosen for consideration because 2-5 is tangent to the curve at the place of observation. Thus one of the rays from 2 is 2-5, along which 2 is seen directly (neglecting the slight curvature due to heat refraction). Of the many other rays which may originate at 2 and be reflected from the curve is chosen also a particular ray 2-3, which will be reflected on the line 3-6. Along this line the observer may see 2 at 2' on a continuation of 6-4, or not see it at all, depending on a contingency that is now to be described.

Between 2 and 4 are two different paths, originating at 2 and crossing at 4. One is 2-4 direct, the other 2-3-4 by a longer route. Light moves at a definite velocity, and in very short waves whose lengths differ with the colors of the light. If the difference between the lengths of the two routes differ by half a wave length of some particular color, cancellation of that color at 4 will occur, and the observer will see at 4 a band that is somewhat darkened by its absence. In fact a dark band may be seen when he looks toward 4 on any line in the included angle 5-4-6.

Now by original assumption point 3 on the curve is the particular one which corresponds to cancellation, or interference as it is called. At the same time, though the scope field may subtend only three degrees of angle, there are many possible curves of light refraction other than 1-3-5, on some

(Continued on Page Fourteen)

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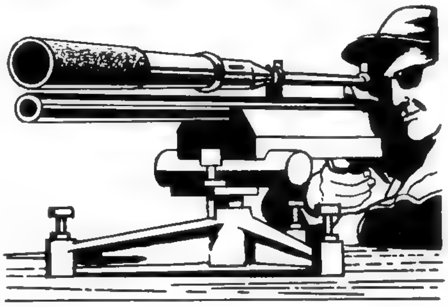

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Wind and Mirage

(Continued from Page Thirteen)

of which, at one particular point, a cancelling ray will be reflected. However, as the travel distances of their cancelling rays will differ progressively, it is obvious that the vertical dark lines will be repeated in the field at fairly constant intervals. Still further, if the whole body of unequally warmed air is slowly moving, then the whole system of light and dark bands will move and give the familiar appearance of flowing waves.

In the other branch of the mirage subject, pure light refraction precludes the seeing of the target in its right palce. In fact, in the opinion of this writer, the outdoor target in summer is seen in exactly its right place only when falling rain cools the ground fast enough to prevent heat radiation or absorption. For this reason the prone shooter who, indoors can fire clean targets with machine like regularity, outdoors may have an H of a time just to fire one clean target.

Because of light refraction the eye may be deceived momentarily as to position of the target, often with no advance notice. This is most likely to occur on hot, bright, and fairly calm days, but also it may occur on dark, cool days. All that is required for it to happen in that the temperature of the ground be different from that of the air above it. Then, no matter which one is the warmer, the temperature of air close to the ground will vary with distance above ground.

The reason why the target is not seen in its right place is explained in what follows. When one looks obliquely through unequally heated air the degree of deception depends on the accumulated angle of refraction. In the vertical plane, if the air at the ground is warmer than air above it, the sight line is cumulatively bended upward when a shooter lies on the ground and fires at a target which is some feet above ground. The target is seen lower than it is; and so, in order to hit it, the rear sight is elevated.

Owing to this elevation an occasional subsequent shot may go high or low. The reason why is a corollary of the above principle. Nominally the temperature of the warm air stratum is inversely proportional to the wind velocity because, the faster the air moves the less heat a unit of it receives from the ground by conduction. So, if the wind picks up, the air temperature falls, the angle of refraction is diminished, and the shot goes high and sidewise in proportion to the velocity increase. For converse reasons, if the wind velocity falls the shot may go low and not so far sidewise. Moreover, a high or low shot may be caused by a change of wind direction if the length of the wind runway over bare ground is changed thereby. This might occur if the range is bordered on one side by an open field and on a different side by woodland.

If the ground is colder than the air moving over it, the directions of the refractive errors are the reverse of those described above.

Deviation of the sight line in the lateral direction involves the principles of refraction in a different way. When you look obliquely through a sheet of plate glass, refraction in the glass causes the light ray (sight line) to bend toward a perpendicular to the plane of the sheet at the place of entry. This puts a jog in the sight line, with the rays outside the glass parallel, but not in the same straight line. In the shooter's problem, if you look obliquely through a current of air in which the density is less than that of the air which surrounds you, refraction in the thinner air causes the sight line to bend away from a perpendicular to the air current at the place of entry. If the order of the densities be reversed the sight line is bent in the opposite direction.

Now in general the air over a mown range is warmer than the air over the bounding region. Moreover, the warmest spots are at the storm centers, whose mean is likely to be stationary near the center of the range under the conditions of most refraction, which occur when the air is very nearly stagnant. At the same time because the mean storm center is the warmest spot, in whatever circulation there is, the isotherms, viz, line of equal temperatures, obviously will be parallel or tangent to the wind direction at any chosen point. Thus, as temperatures increase with nearness to the mean storm center, the isotherms which are tangent to the wind at any place, not only are lines whose individual temperatures differ, but also are lines crossed obliquely by the sight line where the wind is oblique to that line. Bending of the sight line sidewise in a horizontal plane is the obvious result.

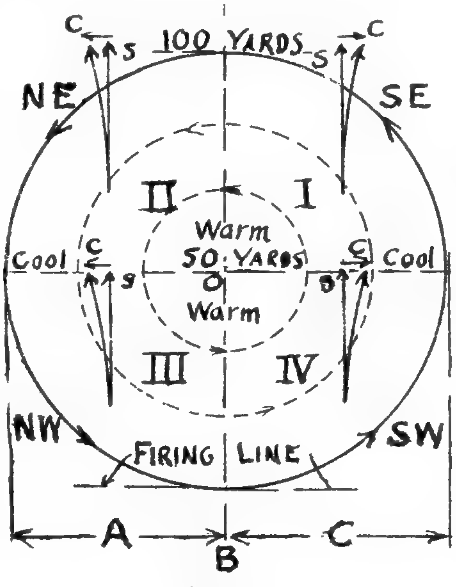

FIG. 4

These principles lead to conclusions which are explained with the aid of Fig. 4. This figure refers to a range which is fairly well enclosed by hills, trees, or bushy fence rows, namely a range over which a local, circular wind is likely to blow. Geographical wind directions are used here on assumption that the direction of fire is north. For other directions of fire the same diagram is applicable if clock directions are substituted. For example if firing is to the south, NW becomes SE, but still is 10:30 by the clock.

Denoted by O is the storm center which, of importance to remember, is on the right of a shooter when he faces the wind that he feels (unless it be a prevailing wind). The curved arrows indicate directions in which the sight line is bent while passing through the corresponding vicinity. Those marked S denote the line on which the object is seen. Arrows C denote the directions of the windage needed to compensate for the aberrations.

For a shooter at B there is no aberration of light nor unbalanced wind component to compensate for, this because the sight line is normal to the wind components and it passes through the storm center. Thus as is often the case in mirage shooting the score may depend on not who you are but where you are.

In the zone A the wind at the firing points will in general blow from the NW. If the shooter fires across quadrants III and II at a 100 yard target, the wind effects themselves will cancel. However, as is indicated by the directions of the arrows marked C, he will need left windage in proportion to the sum of the aberrations in each separate quadrant. If the left windage taken is that for the average refraction, a subsequent shot will go to the left if the refractive condition diminishes, or to the right if it worsens.

If now this shooter in the zone A fires on a 50 yard target his refraction correction will still be left windage, but in lesser amount as only quadrant III is involved. The direction of his wind correction for this quadrant is the same as that of the refractive correction, but the need for wind correction will be almost nil under the assumed condition of negligible wind for significant light refraction.

For a shooter firing in the zone C the governing principles are the same, but the direction of the refraction correction is right instead of left, and for 50 yard shooting the direction of the wind correction agrees with instead of opposes the refractive, perhaps a light NW wind in mirage weather is more favorable than a light SW wind.

If NE or SE winds blow at the firing point, either they are prevailing winds, or else the storm center of the circular wind is somewhere behind the axis of the firing line. In either case the above principles and Fig. 4 are not directly applicable, but there is an underlying broad principle which is applicable.

The broad principle is this: No matter what the direction of the wind, nor whether the wind is a circular or prevailing one, or a combination of both, if the warmest area is on the left of an axis through the plane of fire, the direction of the needed windage is right; if the warmest area is on the right of this plane the direction of the correction is left. Moreover, what is important to remember, a change of strength or direction in the wind may bring about a significant change in the refractive index, or even move the controlling warm spot to the other side of the plane of fire.

An illustration of these and other principles is shown in the following account of an actuality. Behind the 100 yard butts, on a range where the direction of fire was south, there was a long, sloping, low hill which served at backstop. On the left and adjoining the range was a shallow vale or hollow, wide as the range and twice as long. Air coming up this vale on the very light 11 o'clock wind moved over twice as much ground in the vale as did air coming over the range from the butts. Thus the warmest region was in the vale and on the left of the plane of fire.

As all day no wave flow was visible, only the sight-in corrections could give advance notice of this peculiar heat condition. As to these corrections themselves, I can speak only for the left end of the line. Firing slightly downhill through refractive air, less elevation was needed. Owing to the warm region on the left more than a minute of right windage was normally required according to sight-in corrections. In the lulls and periods of light fishtailing, when temperatures were builded up under conditions which were scarcely distinguishable from the prevailing ones, the requirement for right windage was more than doubled. If the need was not foreseen, and it could not be, shots went out high and left, even to the 8-ring.

All the above rules of course are not hard and fast rules, but they hold generally if the actual conditions are those here predicated. Naturally they apply best on nearly windless days when the refractive error exceeds the wind error many times over.

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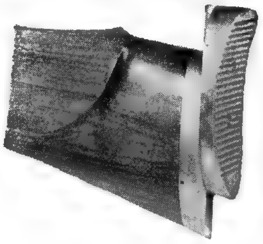

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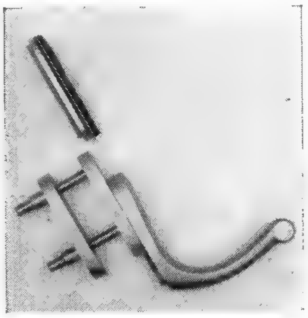

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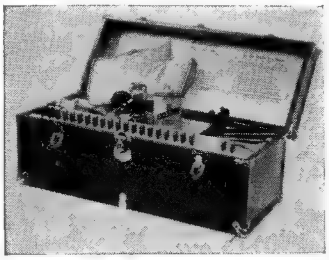

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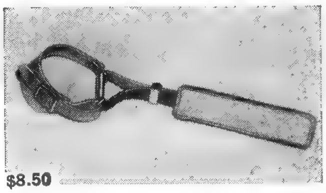

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Sun or not, refraction may be expected when a change of weather has brought about a marked difference between air and ground temperatures. In fact the basic cause of all such aberrations is a difference in temperature between air and earth, for temperature difference is a prerequisite of heat exchange. Thus it is common to find significant aberration on cool and dark days, too.

The existence of the refractive condition may be recognized by various symptoms which are manifested in the results of firing. Among them one is the need of clicking down on bottom row bulls to prevent the shots from going out at 12 o'clock and, at the start of the next match or stage, clicking up on the top row bulls to get the shots inside the 10-ring at 6 o'clock. Another indication is discovery that shots go to the side toward which the wind is blowing when the wind slacks off.

On hot, bright days a careful study of the appearance of the target with a good spotting scope will pay off if one is able to anticipate the changes. If all the bulls look alike and are distinct as if only inches away, maybe there is no significant refraction in the air. A moderate degree of it is signified by spotting difficulties, even though the rings are tolerably clear. Still more is signified if the rings are blurred and dancing or distorted. Finally, if bullet holes at 100 yards fade out, and if at 50 even the bulls shake, or the very paper seems to undulate, then is the time to hold the fire.

In general when wind is light and refraction is strong the lulls are pregnant with disaster. At such times the position of the conrtolling warm spot may undergo a change, or thermal cells may occur in a different formation. For these reasons it is better to fire when the air is stirring, though one should be very cautious after a change of strength, or when the wind first starts up after a lull, or after there has been a significant change of light.

It is very difficult to determine the unaffected sight readings for the standard outdoor smallbore ranges. At best they may be only surmised on the results of firings under many different conditions. But if these readings can be determined with tolerable accuracy, they may be put to practical use. If it be a day of wind the shooter may estimate the average effect of it by the correction needed to sight in. If it be a day of comparative calm he may judge by his sight-in elevation whether the air is highly refractive, and by his windage correction determine the side on which the controlling warm region is momentarily located.

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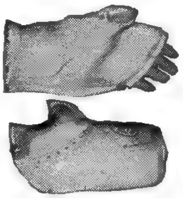

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With such information, plus a knowledge of the topography of the surrounding region, he knows at least where to post his guards. But, like the weatherman, he is bound to miscalculate occasionally.

A source of misinformation is the mistaking, on a hot, bright day, the effects of barrel warping for refractive error. On the inside of a barrel, heat is uniformly imparted to the metal on the circumference of the bore by the hot gases. The outside of the barrel is warmed by the sun on the side where the sun shines. After the barrel temperature has risen above the prevailing air temperature, irregular cooling by wind occurs. The results may be a chaotic warping of the barrel which begins very

(Continued on Page Sixteen)

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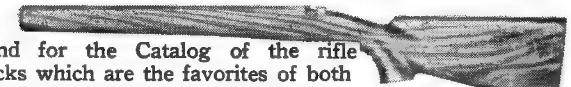

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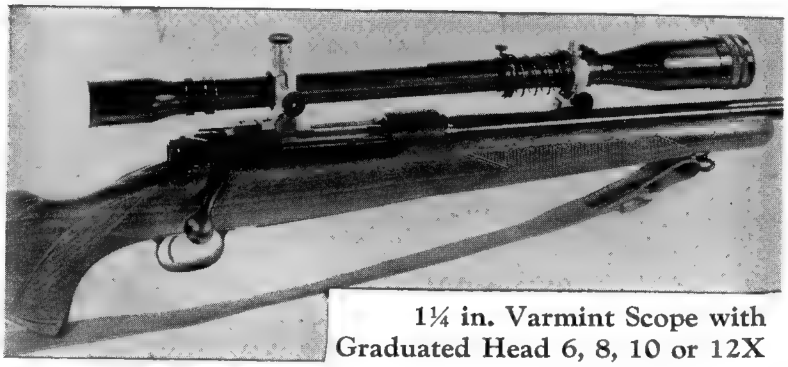

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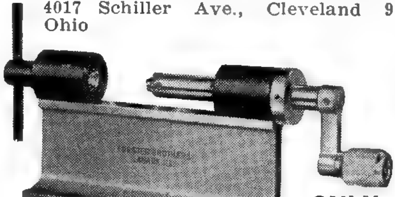

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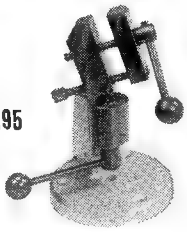

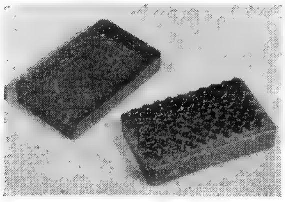

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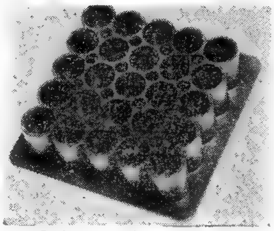

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Wind and Mirage

(Continued from Page Fifteen)

suddenly and is manifested by a total failure of the barrel to group. Shading the barrel, maybe for as little as five minutes, may restore it to temporary accuracy; but it is better to preclude the trouble by insulating the barrel against the sudden temperature changes which are caused by sun and wind.

Altogether it is apparent that skill of the highest order is needed to lie on the ground, either in wind or heated air, and fire good scores on targets the radii of whose 10-rings are only a fraction of the possible deviations which are due to the ordinary conditions of outdoor firing. To do this in wind is a matter of skill which may be learned by experience; to do it in highly refracted air is mostly a matter of luck.

BULLET BEHAVIOR ON GAME

Dear Mr. Teachout:

Some time ago, you mentioned that you would be interested in hearing of the performance of hollow point bullets on game, and I wrote you that I had had good experience last year with the Sierra 168 grain International open point bullet at about 3000 fps or slightly more.

I killed two more mule deer this fall with the same bullet, but using 74 grains of 4831, in the .30 Newton. This load chronographed 3050 fps in my gun, and appears to have good consistency. I was not so satisfied this year. Deer #1, a big spike, was hit broadside through the stomach at about 100 yards; the exit hole was about 1½ inch, and the guts were not badly damaged; I suspect the bullet did not open at all. He went down, but got on his feet again after a few seconds, and started to walk away. I hit him again, the bullet entering at the rear of the rib cage, severing about 3 ribs, and he was dead. In quartering him, I cut into some very small bullet fragments in his neck, but never found the main chunk of the bullet, or any exit hole from the second shot.

Deer #2, a small spike, was hit from the rear quarter, high in the shoulder. It made a horrible wound, breaking up the shoulder blade and wasting a lot of meat. It was obvious that the animal was going to be a long time dying and a finishing shot was required.

Although they are very accurate, and every one of the shots would have killed eventually, I think I will abandon the use of this bullet. I don't think it can be counted on to open up unless it hits bone.

I also killed two this fall with the Sierra 100 grain Spitzer 6 m/m bullet. This was loaded ahead of 43 grains of 4831 in the .243, which chronographs a fairly consistent 2985 fps in my gun. The first, a small spike, was hit with a perfect neck shot at about 100 yards, which tore a big chunk out of his throat, without hitting bone, killing instantly. The second, a small three pointer, was running broadside to me about 60 yards away when hit through the heart. The bullet went clear through, leaving a 1½ inch exit hole and making a horrible mess of heart and lungs. He ran another 75 yards, pumping blood in great quantities out the exit hole, before he dropped dead. He never missed a stride, at the shot, and I thought I had missed, but a friend who was standing with me said he ducked a little, so we went looking and found him.

I have heard a lot about Sierra bullets going to pieces too fast, so I fired one of these through an aspen about 9 inches thick; it went into an adjacent tree about an inch. I dug it out and found that the jacket had peeled back perfectly, and it looked as if about a third of the lead was left in the cup. Unfortunately it fell out of my pocket before I got home, so I couldn't weigh it.

Harry Jackman
Arcadia, California

ISU Course National Championships

(Continued from Page Three)

Marine Corps won the four-man team event with 2327 X 2400 over Air Force with 2312 and Army's 2301.

INTERNATIONAL THREE POSITION SMALLBORE RIFLE: Army riflemen took the three top spots in the 40 competitor field, Cpl. Gary L. Anderson winning with a three day aggregate of 3402 X 3600, Capt. Daniel B. Puckel second with 3386 and 1st Lt. Tommy G. Pool third with 3378. T. Y. Wu from Ann Arbor, Mich., was high civilian with 3262.

INTERNATIONAL 300 METER FREE RIFLE: Winner Capt. Daniel B. Puckel with a three stage aggregate of 3425 X 3600. Cpl. Garry L. Anderson was runner-up with 3416 and 1st Lt. Tommy G. Pool was third with 3369—all three members of USAAMU at Fort Benning. T. Y. Wu, Ann Arbor, Mich. was high civilian with 3173.

INTERNATIONAL CLAY TARGET EVENT: Winner was civilian Dr. Gordon C. McLaughlin of Terre Haute, Ind. Dr. McLaughlin was tied with Army Sgt. Major Harold A. Grewe going into the final 25-bird string, both with a 268 bird tally, and broke all 25 birds for a final 293 X 300 while Grewe missed one bird for a final runner-up 292. Army 2nd Lt. Gordon D. Horner was third with 288 (after winning a shootoff with Air Force Major Frank Knapp).

INTERNATIONAL CENTER FIRE PISTOL: Winner, Army SFC William B. Blankenship with (score missing). Runnerup was Marine Capt. William McMillan with 1766 and third was Army SFC Samuel W. Hunter with 1765. Air Force Capt. Franklin Green had 1763. High civilian John R. Hurst had 1726.

BOOK REVIEW

CARTRIDGE CONVERSIONS, by Capt. George C. Nonte, Jr. The Stackpole Co., Harrisburg, Pa., 1961. $7.50.

Capt. Nonte, Ordnance Corps, U. S. Army, is well and favorably known. His CARTRIDGE CONVERSIONS is a most excellent and needed book for handloaders. No other work competes with this fine book. The introduction is written by John T. Amber, well known editor of the famous GUN DIGEST.

Numerous clear illustrations in the 340 pages help explain the text. Chapters fully cover Tools and Equipment, General Information, Calibre Determination, Case Selection, Primers and Priming, Special Cases, Bullets, Metric Conversino Table, and other subjects related to case forming. An extremely valuable section contains over 300 cartridge data sheets for an equal number of obsolete and current foreign, English and U. S. cartridges. All necessary working instructions and loads are included. Be-assured the book will be a reference work in the library of all handloaders who may form cases, or want to learn about it, and in the library of all the tool and die makers.

Capt. Nonte is an ardent handloader, and a partner in a growing custom loading business. His book contains information that cost mnay thousands of dollars to obtain and assemble, and years of diligent effort. The Stackpole Co. has added another classic to their large number of fine books on firearms and related subjects.

(Continued on Page Eighteen)

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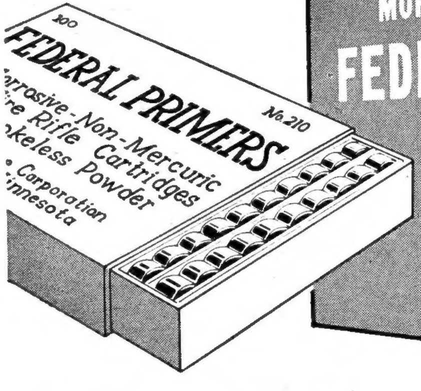

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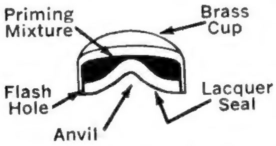

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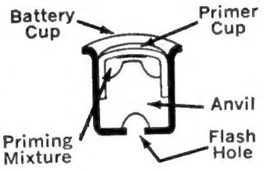

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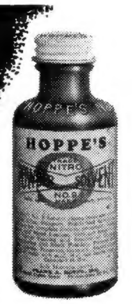

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Book Review

(Continued from Page Seventeen)

Capt. Nonte did a wonderful job in making his store of information available to all handloaders.

You may be interested in using cheap (or free) 30-06 G. I. hulls for the simple job of making .270 or .243 cases, or the more complicated 6.5 x 54mm. Or perhaps you want to load for foreign rifles with U. S. primers, and no ammo available. Maybe you want to shoot the soft coal burners of yesteryear. The dope is here to keep 'em shooting!

In my handloading columns in GUNS Magazine, SHOOTING TIMES, and other periodicals, I've refrained from recommending loads with formed cases, except the most simple types. This was because no specific work with detailed instructions has been available to the average guy. With Capt. Nonte's fine book, even a novice reloader can follow clear, simple, detailed instructions and obtain good results. The book fills a void, giving specific information that in some cases has been needed for half a century. It's right up to date, with good dope for modern cartridges, as well as the ship loads of foreign rifles that have flooded the nation in recent years.

After devoting most of the past 25 years to reloading for fun and profit, and trying hard to keep up with the best and most modern technique, I've found a great deal of good dope that will come in handy at some time or other. It's a wonderful reference book, and interesting reading.—Kent Bellah.

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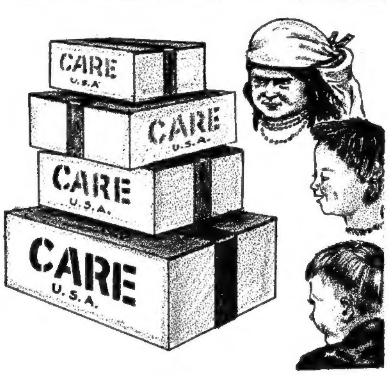
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The Information Bench

The Information Bench service is available to all Precision SHOOTING readers. With your questions, send a stamped, self addressed return envelope for a reply. Selected questions and answers, covering as wide a variety of interests as possible, will be published in these columns. Address your questions to the following people.

Rifles, all types, accessorise, handloading, components and shooting methods:—R. W. Lathrop, The Information Bench, 1695 No. Magnolia, Tucson, Arizona.

Sporting handguns and loading—Kent Bellah, Saint Jo, Texas.

Question: A short time ago I ask Rk Nelson to make me up a .22/250. He has made up a .222 for me which is the most accurate and satisfactory rifle I've ever had.

Instead of the regular .22/250 he has suggested I have made up a .22/250 Long Neck, saying the "we" have found "it" superior to the regular .22/250. Now, I'm ready to go ahead with Nelson's recommendations but have to know **why** and, since he's just started on a hunt for moose and elk, won't be back for a month or so.

Do you know anything about this cartridge? If you do, please tell me why it is superior. Has it the same capacity? Has it as good accuracy? Will I get the same velocity? The reason I want the .22/250 is to get those chucks 60 to 100 yards beyond the reach of the .222. Ben Mecklenburg, New York

Answer: I am much interested in your letter but really I am not sure that I can help you; however I will try.

Many gunsmiths and operators have many ideas of what is the best cartridge. Most of the time the idea is based upon what they think they can sell and they do not always let reason shine in very far. Many people are attracted to something new or different. It may or may not be better than the established.

I have seen and used the long necked Wasp, the long necked .300 Savage and several other long necked jobs but I have never found that they returned any advantage. I do not know in particular about this long necked .22/250 but anything that gives the same powder room (capacity) would require some such case as the .257 or '06 and that poses both a case and die problem over the use of the regular .250/3000 case. If the powder capacity is the same, the speed and range will be the same regardless of the type of neck.

The only good reason at all for a long neck is that it provides a place for the bullet to lie in when using long bullets. It sort of protects the bullet and the theory is that it permits the bullet to get started straight and without being deformed. I personally do not subscribe to this line of reasoning. It is very seldom that you will find cases that have concentric necks. If you will check you will find that the brass is thicker on one side or the other unless, of course, they have been die line reamed and even then they do not remain that way for more than one firing. Now, if the case neck is not concentric just how does the bullet manage to contact the rifling squarely? This is only the matter of one or possibly three or four thousandths but it is just that much out of line and hurts accuracy.

In opposition to this long necked theory and practice there are two other alternatives. One is as Winchester now uses in the new .264 and that is a two diameter bullet, the forward or smaller portion just fitting inside the rifling and thereby insuring that the bullet lies concentric regardless of the case neck, and thus get started straight. Many people found out how important this two-diameter bullet was when they tried to use regular bullets in the .264 and found accuracy could not be had.

The other method is the one I have long used and with much satisfaction in good performing rifles. It works and can be shown to work any time. It is to simply cut a good full throat where the bullet will lie in the rifling when seated but very little in the case neck. This throat must be cut

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concentric with the bore and no larger than will allow a good push fit for the bullet. The bullet will not be seated more than ⅛ inch in the case and often less than that. This method insures that the bullet will always find a constant resting place and get started straight. It is not dependent on some lopsided case to line it up. The length and type of bullet you want to use will determine the throat that is to be cut. It must be concentric and it must not be too large. It must be a push fit for the bullet. The reason that this practice is not in more general use is that it is a little more difficult to do correctly and too many operators have cut the throat too large. This defeats the whole thing and causes inaccuracy. That is the main reason that the so-called free-boring came into bad favor. R. W. Lathrop

Question: In recent magazine articles I read that the flat top post reticle is more useful for deer hunting under conditions of poor light and a woods background than crosshairs or dots. How does the tapered crosshair reticle of the BALvar 8 compare under these conditions?

Also, what would you recommend for a target-varminter semi-finished stock for a Sako heavy barrel L-579 action with scope? Kent M. Newey, Maine

Answer: I do agree that a good medium flat top post with a cross wire just below the top of the post is about the best type of reticle for big game hunting. In this respect the fine BALvar 8 is second best. However, one must consider all the factors involved and the BALvar has some mighty fine qualities to its credit.

In the matter of a stock for a Varmint rifle I personally prefer the "VARMINTER" stock as made by Anthony Guymon of Bremerton, Washington. Many shooters like the Fajen or Bishop type stock. It is just what fits your likes best. Just be sure the action and about two inches of the barrel are well bedded and the rest of the barrel is free—really free. R. W. Lathrop

Question: I have a roll of lead wire for making slugs for bullet cores which has been in storage for about seven years. Naturally, the wire has corroded. I would appreciate your advice on the best method for cleaning this before use in bullet making.

I also have a supply of .222 cartridge cases which are of similar age. I recall reading somewhere a number of years ago of a simple method of cleaning brass cases but cannot recall the method. Could you give me some information on this as well. Joseph A. Elliott, Jr., M.D., North Carolina

Answer: I think that you should try to sell or trade your corroded lead wire for some that is in better shape for bullet making. There may be some chemical process that will remove the lead oxide but I don't know what it is. Most of the oxide can be removed with steel wool but I don't think it is worth while to attempt to clean it. There is too much danger of deforming the wire or of cleaning more on one side than another. One has too much involved in the finished product to run any unnecessary chances with poor cores.

Cases may very well be cleaned mechanically or chemically. Please turn to page 76 of the American Rifleman for September '61 for a good article on cleaning cases.

I have found that tumbling with a good soap and fine steel shot does a fine cleaning job. Get steel shot from the casting foundry about like #8 lead shot. Finish polishing and drying by tumbling with sawdust or ground corn cobs, or simply wash with hot water and dry in the sun or oven.

A very fine chemical cleaner for small lots is called "Case Brite" and is put out by the Case Brite Co. of 1130 Emerson St., Rochester 6, N. Y. A small can of this Case Brite, costing about one dollar, will really shine up several hundred cases in a matter of minutes. R. W. Lathrop

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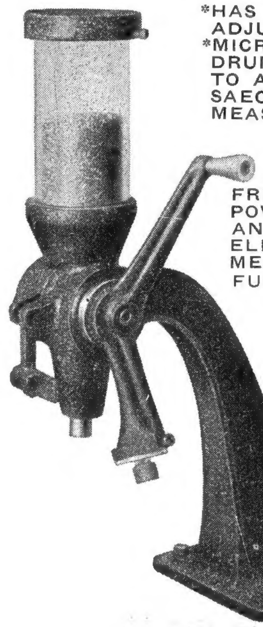

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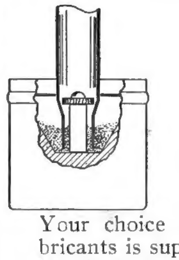

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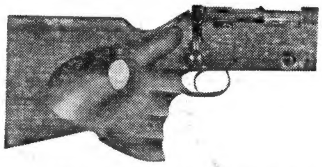

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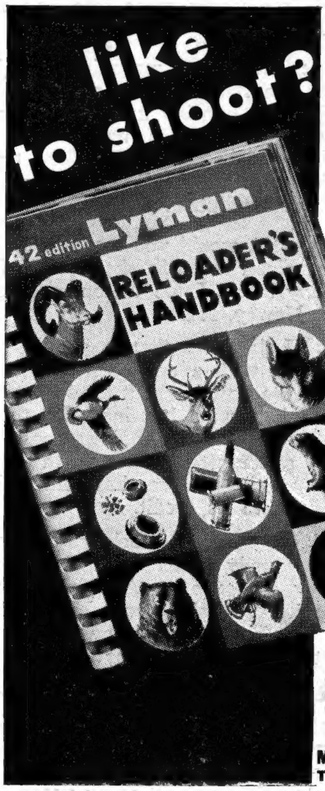

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